JUNIOR SCIENCE DIGEST

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Y SCIENCE JOURNAL FOR THE YOUNG – FOR STUDENTS AT 10+2 LEVEL

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1. National Talent Search Examination
2. I.I.T. & other Engineering Colleges

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Electric Organs in Fishes
Shapes of Molecules
S.I. Units & Their Importance
Asthama

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IMPORTANT ANNOUNCEMENT

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RESULT OF

SCIENCE QUIZ : MARCH 1979

All-correct entries have been received from the following two participants :

1. Master Sachin Lokeshwar C/o
   Mr. S. R. Lokeshwar,
   SPJM, Mathura Refinery Project,
   Mathura-281 005 (U.P.)
2. Master Sukanta Mukherjee C/o
   Lt. Col S. K. Mukherjee, Gynaecologist,
   M. H. Ambala,
   Ambala Cantt.

These participants will be sent **JUNIOR SCIENCE DIGEST** *free* for one year w.e.f. May 1979 issue up to April 1980 issue.

Mr. Kaustuv Bhadra, Ordnance Factory Estate, Type IV Quarters, Block 1/1, Tiruchirapalli-620 016 has earned the distinction of sending all-correct entries to the SCIENCE QUIZ for the third time. He is being sent books worth Rs. 20/- (equivalent to one year's subscrietion to JSD) of his choice. He deserves appreciation and emulation by all our readers.

Readers' Page

Sir,

Since long I was in search of a magazine which can provide extra knowledge and is best in all respects. After a long time I found JSD. I liked it very much because of its good features and qualities.

I am a student of Pre-university (Med.) and find the Junior Science Digest, as knowledge providing magazine. I am very thankful to the Editor and the authors of the magazine. I find NDA model papers and NCERT model papers inspiring.

Rajan Choudhry Prep.
M.MM. Degree College
Patiala

Sir,

I have very much liked your JSD—especially the fluid manner of representing the subject (with plenty of illustrations), which normal students find otherwise quite difficult to grasp. It is an asset for both the teachers and students of 10+2 level. Various topics of Science have been dealt in vivid, precise and easily digestible manner. Diagrams have been included very liberally. No mistake of the press is also one of the features of J.S.D. To speak the truth, JSD is not voluminous but luminous.

Looking into the broad aspect of science, I like to suggest you that the number of pages should be increased and the questions on the different subjects should be published in different groups. Life sketch and works of one scientist should be presented in each issue.

Kedar Nath Thakur,
Lecturer in Chemistry,
Biswanath College,
Charali—784167 (Assam).

Sir,

I am unable to find words to thank you for giving us, readers, such a beautiful opportunity of reading the contents in your JSD. Every month, I enjoy reading this magazine Every article is interesting. I very much wish a bright future for J.S.D.

Mr. Prakash A Bhogle,
H. A, L. Township
NASIK-422207

Sir,

I am a regular reader of your journal JSD. I found interest in reading this journal before my test examination. Now I am a student of Jenkins School, Cooch-Behar of class eleven of Science Stream. I am glad to inform you that I have passed the tenth class examination, conducted by West Bengal Board of Secondary Education, with 73. 2% marks. I have much been benefited by your journal. Accept my hearty congratulation.

I wish JSD will attract the attentions of many students day by day.

Subrata Biswas,
Jenkins School Hostel,
Cooch Behar.

Dear Sir,

Thanks for publishing an article on "Weightlessness" in your regular journal JSD (March '79). This journal seems to be the most informative and suggestive to science students than any other science journal. I have found that it is very useful magazine for the students of 10+2 level. I would be very much obliged if you put down in a nutshell about Einstein's 'Theory of Relativity' in one of the next issues.

Hoping for bright future of JSD.

Arun Kumar Patra,
4/3, Edison Road,
Durgapur-5 (WB).

JUNIOR
SCIENCE
DIGEST
A SISTER PUBLICATION OF CAREERS DIGEST
MONTHLY SCIENCE JOURNAL FOR THE YOUNG

VOL 2 NO. 5 MARCH, 1979

Editorially Speaking:

Our young friends will have reason enough to welcome and treasure this issue of their favourite science journal In continuation of the series of Model Test Papers that we have been giving them in our previous issues (NDA March 1979 issue and National Talent Search Examination for Class X: April 1979 issue), we offer them Model Test Papers for the Entrance Exams of IIT's and other Engineering Colleges in India as well as the NTS Examination for Classes XI & XII, in this issue. We fervently hope that our readers will find them instructive as well as helpful for the forthcoming examinations. Here's wishing them all success in their endeavours.

In this issue we also announce the results of the first JSD Essay Competition. Announcement regarding the second essay competition as also the award of JSD Merit Scholarships will be a special feature of our next issue. In the next two issues of the journal, viz., June and July 1979, we shall give our readers assignments in English, Physics, Chemistry, Mathematics and Biology (Secondary and Senior Secondary Levels) so that they can utilise their summer vacations in a constructive manner.

Our next issue will also contain Model Test Paper for the forthcoming Medical Entrance Examinations. The tests will be based on objective as well thought type patterns that are currently being employed by the various examining bodies in the country. Our readers who are preparing for such tests can look forward to some authentic and well-prepared guidelines in the June issue of JSD.

As the journal marches from strength with the continued patronage of our enlightened readers as well as the various educational bodies in the country, we take this occasion to rededicate ourselves to the cause of science education at the school-leaving level. Please keep us posted with your opinion on the form as well as content of the journal so that we can continue serving the student community at the 10+2 level with renewed vigour and zeal.

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O.P. VARMA

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SCIENCE NEWS

BLOOD CLOTS DISSOLVED

A Moscow surgeon, Professor Valentin Polyakov, has succeeded in dissolving blood clots leading to thrombosis by using ultrasonic device without dissecting the blood vessel.

According to a report in Pravada, the method devised by him involved injecting an intravenous hypodermic needle to send out sonic waves through the stream.

The surgeon has succeeded in dissolving clots within 10 to 12 seconds by this method. After passing the sonic waves physiological salt solution is used to wash out from the vessel lumen. The puncture is then closed by a welded ultra sonic suture.

LASER-ANNEALED SOLAR CELL IS CHEAPER

Lockheed scientists have found a way to mass produce more efficient solar cells using lasers

Using a laser to anneal the cells they have demonstrated efficiencies of 15%—the highest so far obtained. As a result the cost of solar cells is expected to drop.

The laser-processed cell is part of U S. Department of Energy's projcct to cut the cost of the solar cell by a factor of 20.

SATELLITE TO TEST OZONE LAYER

The USA launched a satellite into earth's orbit to test the vital ozone layer which filters the sun's ultra-violet rays.

The 147-kg satellite was put into orbit as part of a $10 million study to check the effects of aerosol pollution.

Scientists have speculated that both man-made and natural aerosols may be eroding the ozone layer causing a subsequent change in the earth's climate and an increase in skin diseases.

A spokesman for the Nationol Aeronautics and Space Administration said the SAGE (Stratospheric Aerosol and Gas Experiment) satellite would stay in orbit for about a year at an altitude of 590 km. and will send the valuable information to be processed by the scientists.

Pollutants threatening the ozone layer range from discharges by road traffic, industry and aerosol spray-can products, to gases from volcanic eruptions.

THE RAY OF HOPE FOR CANCER PATIENTS

Cancer patients literally have a ray of hope as tests in U.S research laboratories show.

A beam of bright light has reduced and in some cases destroyed tumours which have been treated by a light sensitive chemical, according to Dr. Thomas Dougherty, principal cancer research scientist at Rosewell Park Memorial Institute in Buffalo.

The treatment had been used successfully on tumours just under the skin of about 50 patients Dr. Dougherty said, and he is working on a technique that would allow doctors to apply light treatments to tumours buried deep in the body

100% EFFECTIVE

According to another line of research scientists came a step closer to developing a vaccine against cancer.

A vaccime that is nearly 100% effective against all forms of cancer in rats and mice has been developed by scientists at the National Cancer Institute in Bethesda, Maryland, Dr. Robert Huebner announced.

Dr Huebner, 65, who headed the research project said the vaccine was "species-specific", meaning the mouse vaccine works only in mice and the rat vancine only in rats.

However, the scientific principles that led to the development of these vaccines might make it possible to develop a similar vaccine for humans, he said.

The vaccine opereted on the same basis as those for such diseases as polio and measles.

The organism which caused the illness is injected in a tiny quantity or a weakened condition—into patients, whose bodies respond by producing natural defences against the invation.

The next time the body is exposed it has an army of defences waiting

Dr Huebner said cancer-causing agents, including some chemicals and viruses produced genetic changes that transformed normal cells into cancer cells.

The damaged portion of the gene, which caused cancer cells to multiply out of control, could be removed from cancer cells by using certain kinds of viruses, he added.

Model Test Papers

Entrance to I.I.Ts And Other Engineering College

MATHEMATICS

Time allowed—3 hours Maximunm Marks—100

Notes :—(1) Attempt questions from either Part I or part II (New Mathematics) but not from both.

(2) Questions must be answered in English.

(3) Use of Logarithmic tables and Graph paper is not allowed.

Part I

Notes :—(1) Question No. 23 is *compulsory*. It carries 10 marks, with 2 marks for each part.

(2) Attempt any *eighteen* questions from the remaining 22 questions. Each of these questions carries 5 marks.

Q. 1. Prove that, the square of

$$\left[\frac{2+\sqrt{3}}{\sqrt{2}+\sqrt{2+\sqrt{3}}}+\frac{-2\sqrt{3}}{\sqrt{2}-\sqrt{2-\sqrt{3}}}\right]$$

is a rational number

Q. 2. The sum of n, 2n, 3n terms of a G.P. series are respectively S_1, S_2, S_3. Prove that

$$S_1(S_3-S_2)=(S_2-S_1)^2$$

Q. 3. If $a=xy^{p-1}$, $b=x\,y^{q-1}$ $c=xy^{r-1}$, show that $a^{q-r}.\,b^{r-p}.\,c^{p-q}=1$

Q. 4. If the roots of the equation $ax^2+bx+c=0$ be α and β and those of the equation $Ax^2+Bx+C=0$ be $\alpha+\lambda$ and $\beta+\lambda$, prove that

$$\frac{b^2-4ac}{B^2-4AC}=\left[\frac{a}{A}\right]^2$$

Q. 5. If $x=a+b$, $y=a\omega+b\omega^2$, $z=a\omega^2+b\omega$, show that $x^3+y^3+z^3=3(a^3+b^3)$

Q. 6. Solve

$$2^{3x-2y}=3,\ 4^{2(x-y)}=5$$

$$\text{Ans.}\left[x=\frac{\log 3}{\log(3/2)},\ y=\frac{\log 2}{(\log 3/2)}\right]$$

Q. 7. If a, b, c be in A.P., b, c, a in H.P. prove that c, a, b are in G.P.

Q. 8. If $y+\frac{y^3}{3}+\frac{y^5}{5}+\dots\dots$

$$=2\left(x+\frac{x^3}{3}+\frac{x^5}{5}+\dots\dots\right)$$

prove that $x^2y=2x-y$

Q. 9. Show that

$$\frac{C_1}{C_0}+\frac{2C_2}{C_1}+\frac{3C_3}{C_2}+\dots\dots+\frac{nC_n}{C_{n-1}}=\frac{n(n+1)}{2}$$

Q. 10. There are p rupees, q 50 P, coins and r 10 P coins, find the number of ways of selecting at least one coin out of them.

Ans. [(p+1) (q+1) (r+1) — 1]

Q. 11. If $A+B+C=2S$ show that

$$\sin(S-A)+\sin(S-B)+\sin(S-C)-\sin S=4\sin(A/2)\sin(B/2)\sin(C/2)$$

Q. 12. Solve the equation for θ

$$\sin\left[\frac{n+1}{2}\right]\theta=\sin\left[\frac{n-1}{2}\right]\theta+\sin\theta$$

$$\text{Ans.}\left[m\pi,\ \frac{4m}{n+1}\pi,\frac{4m}{n-1}\pi\right]$$

Q. 13. The median A D of a △ ABC is perpendicular to AB, prove that

$$\tan A+2\tan B=0$$

Q. 14. P and Q are points on the bank of a straight stretch of a stream, and R is a point on the opposite bank, d is the width of the stream and l is the distance P Q. If the angles RPQ and RQP are found to be α and β, show that

$$d=l\,\frac{\sin\alpha\sin\beta}{\sin(\alpha+\beta)}.$$

Q. 15. If m_1, m_2 and m_3 be the lengths of the medians to the sides a, b and c of the △ABC, prove that

$$m_1^2=\frac{2b^2+2c^2-a^2}{4},\ m_2^2=\frac{2c^2+2a^2-b^2}{4},$$

$$m_3^2=\frac{2a^2+2b^2-c^2}{4}$$

Q. 16. The diagonals of a cyclic quadrilateral are at right angles. Prove that the perpendicular from the point of their intersection on any side when produced backwards bisects the opposite side.

Q. 17. Construct a triangle of which three medians are 5.4 cms, 4.5 cms and 6 cms.

Q. 18. P and Q are two points whose coordinates are $(at^2, 2at)$, $\left[\frac{a}{t^2}, \frac{-2a}{t}\right]$ and S is the point (a,0), prove that

$\frac{1}{SP}+\frac{1}{SQ}$ is constant for all values of t

Q. 19. A variable line through a fixed point meets two fixed lines in A and B and the parallelogram OACB is completed. Find the locus of C.

Ans. $\left[\text{locus of C is } \frac{h}{x}+\frac{k}{y}=1\right]$

Q. 20. Find the equation of the circum-circle of the triangle whose sides are given by th equations $x+y=6$, $x-y=4$, $2x-y=3$.

Ans. [Equation of circle is $x^2+y^2-2x+2y-18=0$]

Q. 21. The altitude of a pyramid is 3x. The pyramid is separated into three solids of volumes v_1, v_2, v_3 by two planes, which are parallel to the base and trisect the altitude. Show that $v_1 : v_2 : v_3 = 1 : 7 : 19$.

Q. 22. A cone of height 45 cms and radius 15 cms is lowered vertically downwards (with its base downward) into a tub full water to a depth of 30 cms Find the amount of water (in litres) which will over flow.

Ans. [10 2143 litres]

Q. 23. (i) Solve the equation

$$\sqrt{x+1}+\sqrt{x-1}=\sqrt{4x-1}$$

Ans. $\left[x=\frac{5}{4}\right]$

(ii) If $\tan \alpha=\frac{5}{8}$, $\tan \beta=\frac{1}{11}$, prove that $\alpha+\beta=\pi/4$

(iii) Find the sum of n terms of a series whose nth term is $3n^2+2$.

Ans. $\left[\frac{n(4+1)(4+2)}{2}+2n\right]$

(iv) Express $\left\{\frac{\cos\theta+i\sin\theta}{\sin\theta+i\cos\theta}\right\}$ in the form $x+iy$

(v) Draw the graph of $y=\sin x+\cos x$ for $0 \leq x < 2\pi$

Part II

(New Mathematics)

Notes :—(1) Question No. 23 is *compulsory*. It carries 10 marks with 2 marks for each part.

(2) Attempt any *eighteen* questions from the remaining 22 questions. Each of these questions carries 5 marks.

Q. 1. Out of 160 students who secured first class marks in Mathematics or in Physics, 100 obtaind first class marks in Mathematics, 20 in Physics and Mathematics. How many students secured first class marks in (i) Physics (ii) Physics only ?

Ans. (80, 60.)

Q. 2. The sum of n, 2n, 3n terms of a G.P. series are respectively S_1, S_2, S_3 Prove that

$$S_1(S_3-S_2)=(S_2-S_1)^2$$

Q. 3. If $a=xy^{p-1}$, $b=xy^{q-1}$, $c=xy^{r-1}$, show that $a^{q-r}\,b^{r-p}\,c^{p-q}=1$

Q. 4. If the roots of the equation $ax^2+bx+c=0$ be α and β and those of the equation $Ax^2+Bx+C=0$ be $\alpha+\lambda$ and $\beta+\lambda$ prove that

$$\frac{b^2-4ac}{B^2-4AC}=\left[\frac{a}{A}\right]^2$$

Q. 5. An integer m is said to be related to another integer n if m is a multiple of n, check if the relation is reflexive, symmetric and transitive

Q. 6. Sketch the solution set of the following system of inequations.

$x^2+y^2-4x \geq 0$, $2x+y-11 \leq 0$, $x-y \leq 0$, $y \geq 0$

Q 7. If x^3+3x^2+4x+k and x^3+x^2+8 have the same remainder when divided by $x+3$, find the value of k

Ans. k=2.

Q. 8. If $a^x=b^y=c^z$ and a, b, c, are in G P. Prove that x. y, z are in H. P.

Q. 9. Show that

$$\frac{C_1}{C_0}+\frac{2C_2}{C_1}+\frac{3C_3}{C_2}\cdots+\frac{nC_n}{C_{n-1}}=\frac{n(n+1)}{2}.$$

Q. 10. There are p rupees q 50 paise coins and r 10 paise coins, find the number of ways of selecting at least one coin out of them.

Q. 11. If $A+B+C=2S$, show that $\sin(S-A)+\sin(S-B)+\sin(S-C)-\sin S = 4\sin(A/2.)\sin(B/2.)\sin(C/2)$

Q. 12. Solve the equation for θ

$$\sin\left[\frac{n+1}{2}\right]\theta - \sin\left[\frac{n-1}{2}\right]\theta + \sin\theta$$

Ans. $\left[m\pi,\ \frac{4m}{n+1}\pi,\ \frac{4m}{n-1}\pi\right]$

Q. 13. The median AD of a △ ABC is perpendicular to AB, prove that

$\tan A + 2\tan B = 0$

Q. 14. Evaluate

(i) $\underset{x\to 0}{\mathrm{Lt}}\ \frac{\tan x - \sin x}{x^3}$ Ans. $\frac{1}{2}$

(ii) $\underset{x\to 2}{\mathrm{Lt}}\ \frac{\sqrt{(5x-8)} - \sqrt{x}}{x-2}$ Ans $\sqrt{2}$.

Q. 15 Find the derivative of $\cos(ax^2+bx+c)$ with respect to x, from the first principles.

Ans. $\mp(2ax+b)\sin(ax^2+bx+x)$.

Q 16. Evaluate the following integrals

(i) $\int \frac{1}{\sqrt{3x+2} - \sqrt{3x-4}}\,dx$

Ans $\frac{1}{27}[(3x+2)^{3/2}+(3x-4)^{3/2}]+C$

(ii) $\int \frac{1}{1+\sin x}\,dx$

Ans. $\left[-\tan\left(\frac{\pi}{4}-\frac{x}{2}\right)+C\right]$

Q. 17. Construct a triangle of which three medians are 5.4 cms, 4.5 cms and 6 cms.

Q. 18. On the circumcircle of a triangle ABC take a point P and construct the images of P in BC, in CA and in AB as P_1, P_2, P_3 lying in a straight line which is parallel to Simson line of P.

Q. 19. Find the equation of a circle which passes through (2, 3) and (—1, 2) and has its centre on the straight line $2x-3y+1=0$

Ans. $x^2+y^2-2x-3y-3=0$

Q. 20. Find the equation of the circum-circle of the triangle whose sides are given by the equation $x+y=6$, $x-y=4$, $2x-y=3$.

Ans. $x^2+y^2-2x+3y-18=0$.

Q 21. If m things are distributed among 'a' men and 'b' women, show that the chance that the number of things received by men is odd is

$$\frac{1}{2}\times\frac{(b+a)^m-(b-a)^m}{(b+a)^m}$$

Q. 22. Define the standard deviation. Calculate the mean, median and standard deviation from the following table.

Class interval	1-5	6-10	11-15	16-30	21-25	26-30	31-35	36-40	41-45
Frequencies.	7	10	16	32	24	18	10	5	1

Ans. 20.36, 8.8

Q. 23. (i) If $0<\theta<\pi/2$ and θ is measured in radian, prove that

$\sin\theta<\theta<\tan\theta$

(ii) Draw the graph of $y = |x+|/^{1/2}$

(iii) Write the converse and contra-positive of the following statement :

'If the angle of a triangle are equal, then the sides of the triangle are also equal'.

(iv) If $g : N \to N$ and $g(x)=x+1$, find the domain and range of g.

Ans. $\left[\begin{array}{l}\text{Domain : } (1, 2, 3\ldots\ldots)\\ \text{Range (: } 2, 3, 4\ldots\ldots)\end{array}\right]$

(v) Solve the equation

$\sqrt{x+1}+\sqrt{x-1}=\sqrt{4x-1}$

Ans. $\left[x=\frac{5}{4}\right]$

CHEMISTRY

Time allowed—3 hours Maximum Marks—100

Note :- (1) Answer *all* questions. Write the answer to all parts of one question at one place only.

(2) All questions must be answered in English.

(3) For calculations use of Log-Tables only is permitted

Q. 1. State whether the following statements are true or false. Give appropriate reasons in support of your answer.

(a) $^{35}Cl_{17}$ and $^{35}Cl_{17}$ are isolars.

(b) Sodium carbonate solution in water is alkaline to litmus.

(c) $^{1}H_1$ and $^{2}H_1$ have similar physical and chemical properties.

(d) Sodium metal can be manufactured.

(e) Aluminium reacts with dilute nitric acid to give nitrous oxide.

Q. 2. Fill in blanks with suitable word (s)

(a) The number of electrons in one Faraday of charge is............

(b) ....and.........are isotopes.

(c) Number of coulombs required to deposit 6.35g of copper is.........

(d) The catalyst used in the manufacture of sulphuric acid by contact process is.........

Q. 3. Tick mark the most appropriate answer in the following questions :

(i) An example of amphoteric oxide is

(a) ZnO

(b) Na_2O

(c) SO_2

(d) CuO

(e) Fe_2O_3

(ii) $ZnCO_3$ can be prepared by adding ....to an aquous solution of zinc sulphate.

(a) $CuCO_3$

(b) Na_2CO_3

(c) $NaHCO_3$

(d) CO_2 gas

(e) K_2CO_3

(iii) The metal which does not react with both hydrochloric acid as well as sodium hydroxide is

(a) Al

(b) Zn

(c) Sn

(d) Mg

(e) Pb

(iv) The one which does not decolourise bromine solution in carbon disulphide is

(a) ethene

(b) propene

(c) ethyne

(d) ethane

(e) propyne.

(v) The electronic configuration which represents a noble gas atom is

(a) $1s^2 2s^2 2p^6 3s^2$

(b) $1s^2 2s^2 2p^6 3s^2 3p^5$

(c) $1s^2 2s^2 2p^6 3s^2 3p^6$

(d) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

(e) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$

Q. 4. (i) Calculate the number of atoms present in 0.56g of iron

(ii) Write the Lewis dot structures of

(a) NO_3^-

(b) Cl_2O_7

(c) C_2H_5OH

(iii) Indicate the nature of linkage in the following compounds :

(a) Al_2O_3

(b) ClF

(c) MgO

Q. 5. Explain the following with appropriate reasons.

(a) potassium chlorate is manufactured by the electrolysis of aq. solution. of NaCl and then adding KCl instead of electrolysing KCl solution directly in an undivided cell.

(b) Heat of neutralization in case of strong acid and strong base is maximum and almost constant.

(c) While precipitating third group cations as hydroxides in the qualitative analysis of cations, ammonium chloride is added prior to ammonium hydroxide.

(d) Nucleus of an atom contains positively charged protons packed together closely.

(e) Caustic soda is not stored in zinc vessels.

Q. 6. (a) Give one chemical test to distinguish between.

(i) Nitric oxide and nitrous oxide

(ii) ethene and acetylene

(iii) sodium bromide and sodium iodide.

(iv) potassium nitrate and sodium nitrate.

(b) What is the oxidation number of nitrogen in

(i) NO_3^-

(ii) NH_3

(iii) $C_2H_5NO_2$

Q. 7. (a) Write the chemical equations of the reactions involved in the following

(i) borax head test

(ii) brown ring test

(iii) flame test for borates

(iv) rusting of iron

(v) extraction of copper from copper pyrites.

(vi) manufacture of ammonia by Solvay process.

(b) give one method of preparation of

(i) H_2O_2 (by electrolysis)

(ii) hypo

(iii) water glass

(iv) calemel

(v) alum (potash)

(vi) anhydrous magnesium chloride

(vii) calcium cyanamide

(viii) super phosphate of lime

(ix) white lead

(x) pure alumina from impure bauxite containing silica as impurity

(c) Write short notes on

(i) galvanization

(ii) aluminothermite process.

Q. 8. (a) State what happens when

(i) SO_2 is passed through acidified $K_2 Cr_2 O_7$ soln.

(ii) O_3 is passed over white shining surface of silver

(iii) Cl_2 gas is passed through hot KOH soln.

(iv) Copper is heated with conc. H_2SO_4

(v) Conc. H_2SO_4 is droped on a crystal of sugar.

(vi) Zinc reacts with very dilute HNO_3.

(vii) White phosphorus is heated with Conc. NaOH soln.

(viii) Cl_2 gas is passed over dry slaked lime.

(ix) ethene is passed through alkaline $KM_4 O_4$ soln.

(x) Sodium acetate is heated with soda-lime.

(b) 0.01 g of magnesium piece was added to 50.0 ml of 0 5 M HCl solution, assuming no change in volume, calculate the molarity of the solution after the reaction is over.

Q. 9 (a) There are two principal isotopes of gallium, having following masses and relative abundances

$^{69}Ga_{31}$ 68.9257 a m u, 60.4%

$^{71}Ga_{31}$ 70.9249 amu 39.6%

Calculate the atomic mass of gallium

(Ans : 69.7)

(b) A mixture consists of 40.0% Mg Cl_2 and 60.0% KCl by weight. What is the total number of chloride ions (Cl^-) in 150 g of this mixture.

(Ans : 1.48×10^{24})

Q. 10 (a) The substance chlorophyll contains magnesium to the extent of 2.72% by weight. Assuming one magnesium atom per chlorophyll molecule, what is the molecular mass of chlorophyll.

(Ans : 893)

(b) The density of phosphorus vapour at 310°C and 775 mm Hg is 2.649l^{-1} What is the molecular formula of phosphorus in the vapour form.

Q. 11. (a) Arrange the following in the order as instructed.

(i) HF, H Cl, HBr, HI (increasing order of strength of the acid)

(ii) O_2, He, H_2, CO_2 (increasing order of b p)

(iii) (H_2, He, CO_2, N_2 (decreasing rate of diffusion)

(iv) Cu, Zn, Au, Mg (increasing reactivity)

(b) How long will it take to reduce all the ferric ions to ferrous ions in 200 ml of 0.5 M $FeCl_3$ solution if 2.0 ampere of current is passed through.

(Ans : 1hr 20 m in 25 sec.)

(c) An organic monobasic acid gave the following results on analysis : 0.20 g give 0.505 g of CO_2 and 0.0864 g of H_2O and 0 305 g of the acid required 25.0 ml of N/10 NaOH for neutralisation. Find out the molecular formula of the acid

(Ans : $C_7 H_6 O_2$.)

PHYSICS

Time allowed—Three hours *Maximum Marks —100*

Notes :—(1) Answer question No. 1 and five of the remaining questions.

(2) Answers must be in English.

(3) Logarithmic tables may be used

(4) In numerical problems always give proper units.

Q. 1. (a) Why the weight of body is zero at the centre of earth ?

(b) One-fifth of a body remains outside the liquid of sp.gr. 0.9. How much portion of the body will remain outside in the liquid of sp gr. (i) 0.75 and (ii) 0.7.

(c) How does a *compensated pendulum* keep correct time ?

(d) Can you make water boil at a temperature well below 100°C, even at see level?

(e) Let us consider a metallic bar such that its two ends are at different temps. At steady state, what is the relation between (i) the distance which has to be travelled along the bar to attain a certain fall in temp. and (ii) conductivity of the material of the bar ?

(f) A sheet is held normal to the path of propagation of light. At what angle should it be rotated so that the intensity of light falling on it should be reduced to half. Explain your answer.

(g) Light goes from a medium of refractive inden μ_1 to another medium of refractive index μ_2 Give the relation between the two, using general law of refraction.

(h) When a vibrating tuning fork is brought near the mouth of a resonance tube (with proper resonance length), the intensity of sound heard is not max. at the very start but increases to a maximum value. Explain this development.

(i) Four magnets are placed on a drawing board such that two are in magnetic meridian and two are at right angle to the magnetic meridian, and their s-poles are pointing to their common centre which is equidistant from these poles. Draw approximate lines of forces around them.

(j) A current of 1.5 amp is passed through a silver voltameter for 35 minutes. The mass of silver deposited is 3.528 gm. Calculate and *define* electro-chemical equivalent of silver.

Q. 2. (a) Six parallel forces, of magnitudes 1, 2, 3, 4, 5, and 6 respectively, act at six points on a straight line. The distances between the successive forces are respectively 5, 4, 3, 2 and 1, and the first and sixth forces act in the opposite direction to the rest. Find the magnitude and point of application of the resultant.

Q. 2. (b) A vessel contains water and mercury, and an iron sphere floats on the mercury and is completely covered by the water. The volume of the sphere is 100 c c., the density of mercury is 13.6 and of iron 7.8. What is the volume immersed in each liquid ?

Q. 3. (a) The apparent height of the barometer as measured on a certain scale at t° is H_t. Show that the real height at which the column would stand at is given by

$$H_o = H_t \frac{1+at}{1+kt}$$

where *a* is the coefficiedt of linear expansion of the scale, and *k* the coefficient of cubical expansion of mercury.

(b) When the Centigrade scale is used the value of the mechanical equivalent of heat is 4.2×10^7 and the latent heat of steam is 536. By what numbers will these quantities be represented when the Fahrenheit scale is used ?

Q. 4. (a) The pendulum of a clock, regulated to beat seconds at 14°C., becomes lengthened by 1/200,000 per 1°C. rise in temperature. How much does the clock lose per day when the temperature is 17°C. ?

(b) A length of piano wire is just strectched between two points at temperature 20°C :

the temperature then falls to 10°C., the length being maintained constant. Find the tension per square centimetre. (Coefficient of expansion = 0.000011. Young' modulus $=2\times10^9$ grammes weight per square centimetre.)

Q. 5. (a) If f be the focal length of the lens, r the radius of the mirror, a the distance between the lens and the mirror, and u the distance of the object from the lens when the image and object coincide, show that

$$r=uf/(a-f)-a.$$

(b) A cycle wheel has 44 spokes, each 40 cm. long, and 0 2 cm. diameter and their density is 7.8. If they sound, when plucked, a note of frequency 256, calcuate the tension of each, and find an approximate value for the thrust in the rim of the wheel.

Q. 6. (a) The radii of two small conducting spheres are in the ratio of 2 to 3. The smaller one is charged with a single positive unit of electricity, while the larger one has an unknown negative charge. After connecting them by a fine conducting wire (without altering their distance) it is found that the force between them is the same in magnitude as before the connection was made. What was the charge on the larger sphere ?

Q. 6 (b) Assuming that the earth's magnetism is due to a very small magnet at the centre of the earth, show that $\tan D=2\tan\lambda$ where D is the magnetic dip at a place whose latitude is λ

Q. 7. (a) A battery is connected up in series with a carefully calibrated ammeter and a tangent galvanometer ; the latter consists of ten coils having a diameter of 40 cm. The deflection produced is 42° and the ammeter shows that the current is 0. 5157 ampere What is the value of H at the place ?

Q 7. (b) A wire in the form of a circle 10 cm. in diameter is spinning about a diameter as axis (which is placed vertically) at the rate of 10 revolutions per second in the earth's magnetic field ($H=0{\cdot}18$). Calculate the maximum E. M. F. generated during a revolution.

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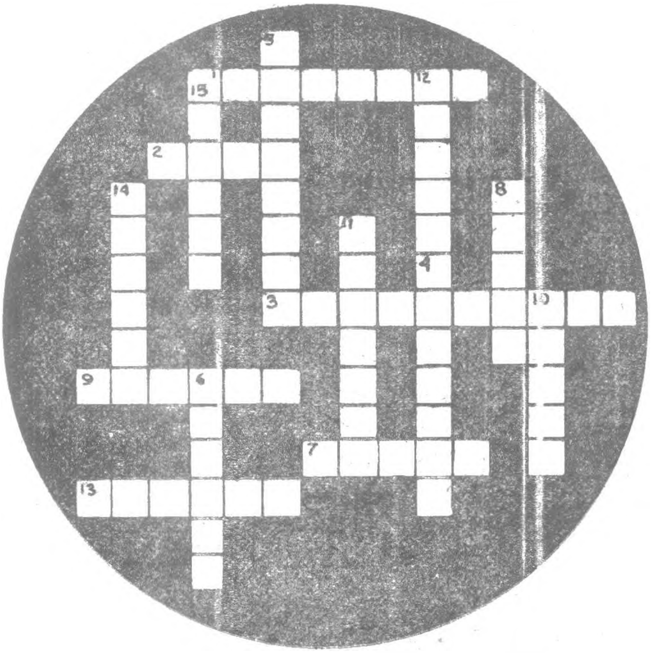
ASTRONOMICAL CROSSWORD—4



CLUES:

ACROSS

(1) A star nearly at the north celestial pole. (8)

(2) A faint star that becomes bright for some days and then again returns to its natural faintness. (4)

(3) The astronomer who constructed the first observatory in the island of Huen (10).

(7) The first known asteroid. (5)

(9) The chief unit in measuring stellar distances, corresponding to nearly 31×10^{12} km (6)

(13) The strip of the sky about 18 degree wide, divided into twelve parts. (6)

N.B. Numbers in brackets indicate the number of alphabets in the required word.

CLUES:

DOWN

(4) ——— effect is used for estimating direction and motion of a star. (7)

(5) The book written by Ptolemy in 150 A.D. dealing with the universe. (8)

(6) A star nicknamed as Dog star. (6)

(8) The star possessing low luminosity. (5)

(10) A star which fluctuates in brightness due to another star moving around it (5)

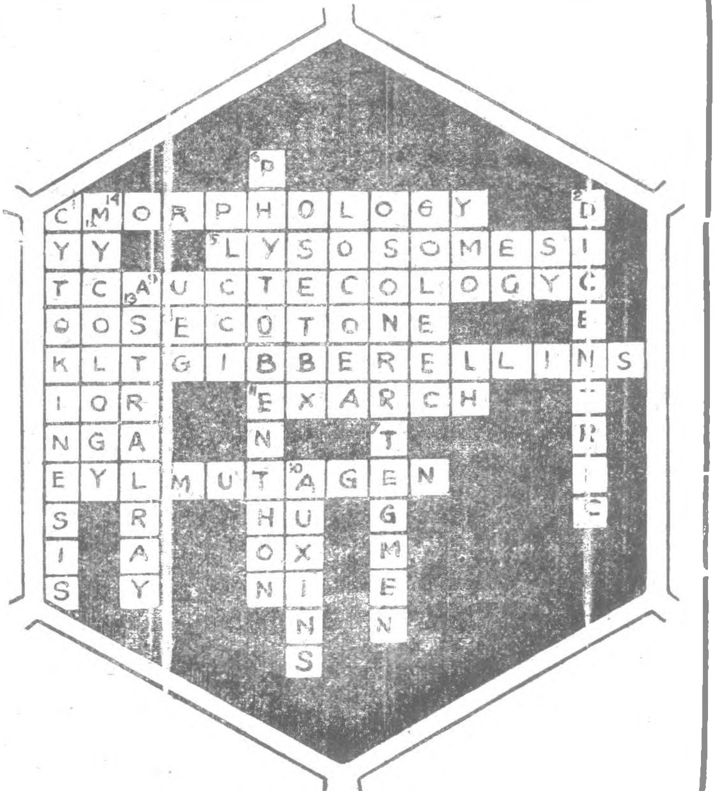
(11) The bright regions near the edge of the sun's disc. (7)

(12) Discovrer of the planet Neptune. (5)

(14) The part of the sun's atmosphere visible during a total eclipse. (6)

(15) A satellite of Mars. (6)

SOLUTION OF CROSS-WORD PUZZLE NO. 3.



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A METHOD OF FACTORISATION

Dr. Asim Kumar Mookhopadhyaya
M.Sc., D. Phil.

To factorise any factorisable quadratic expression of the form ax^2+bx+c, where a, b and c are all real (non-zero), the method of middle-term breaking is very suitable. It strives to find by mental trials two number p and q such that their sum, $p+q=b$, the coefficient of x in the middle-term, and their product, $pq=ac$, the product of the coefficient of x^2 and the absolute term (i.e. the term free from x). Under these assumptions, the expression ax^2+bx+c can be written as

$$ax^2+(p+q)x+pq/a=x(ax+p)+(ax+p)q/a$$
$$=(ax+p)(x+q/a).$$

The above technique can very well be applied to factorise any factorisable general second degree expression in x and y of the form

$$ax^2+2hxy+by^2+2gx+2fy+c$$

where the coefficients are all real and a, b and h are not simultaneously zero. The method will be demonstrated in the general case where all the terms are assumed to be present. It will be shown at the end of the demonstration how the method leads to establish the condition of factorisability of a general second degree expression in x and y. It will not be out of place here to hint that the condition so obtained will also stand for the condition of a general second degree equation to represent a pair of straight lines.

Treating the expression as a quadratic in x (may be so in y also) as under

$$ax^2+2(hy+g)x+by^2+2fy+c$$

the portion $by^2+2fy+c$ is then factorised in usual way as $b(y-\alpha)(y-\beta)$, where obviously

$$\alpha+\beta=-2f/b \text{ and } \alpha\beta=c/b$$

Two numbers l and m are now chosen in order that

$$l(y-\alpha)+m(y-\beta)=2(hy+g),$$

which is the coefficient of x in the expression, and $lm=ab$.

In other words l and m satisfy

$$l+m=2h$$
$$l\alpha+m\beta=-2g$$
$$\text{and } lm=ab.$$

In this situation, the initial expression takes the form

$$ax^2+\{l(y-\alpha)+m(y-\beta)\}x+b(y-\alpha)(y-\beta)$$
$$=x\{ax+l(y-\alpha)\}+(y-\beta)\{mx+b(y-\alpha)\}$$
$$=x\{ax+l(y-\alpha\}+(y-\beta)\{ax+l(y-\alpha)\}b/l \quad \because lm=ab$$
$$=\{ax+l(y-\alpha)\}\{x+b(y-\beta)/l\}$$

or

$$\{ax+l(y-\alpha)\}\{x+m(y-\beta)/a\}$$

which is the required factorisation.

It is to be noted that values of l and m can be found by solving for them from $l+m=2h$ and $l\alpha+m\beta=-2g$ as $l=2(g+h\beta)/(\beta-\alpha)$ and $m=2(g+h\alpha)/(\alpha-\beta)$ which can be expressed finally in terms of known constants b, c, f and g, remembering that α and β are the roots of the quadratic

$$by^2+2fy+c=0.$$

$$\text{Taking } \alpha=\frac{-f+\sqrt{f^2-bc}}{b}$$

$$\text{and } \beta=\frac{-f-\sqrt{f^2-bc},}{b}$$

l and m may be finally computed as

$$l=\frac{h(\sqrt{f^2-bc}+f)-bg}{\sqrt{f^2-bc}}$$

$$\text{and } m=\frac{h(\sqrt{f^2-bc}-f)+bg}{\sqrt{f^2-bc}}$$

Lastly, using the relation $lm=ab$, the condition of factorisability of the proposed second degree expression can be easily established as under

$$lm=ab \quad \text{gives}$$

$$\frac{2(g+h\beta)}{\beta-\alpha}\cdot\frac{2(g+h\alpha)}{\alpha-\beta}=ab$$

$$\text{or } 4(g+h\beta)(g+h\alpha)=-ab(\alpha-\beta)^2$$

$$\text{or } 4\{g^2+h(\beta+\alpha)g+h^2\beta\alpha\}$$
$$=-ab\{(\alpha+\beta)^2-4\alpha\beta\}$$

$$\text{or } 4\left\{g^2+h\left(-\frac{2f}{b}\right)g+h^2\frac{c}{b}\right\}$$
$$=-ab\left\{\frac{4f^2}{b^2}-4\frac{c}{b}\right\}$$

$$\left(\because \alpha+\beta=-\frac{2f}{b} \text{ and } \alpha\beta=\frac{c}{b}\right)$$

On simplification, the required condition of factorisability follows as

$$abc+2fgh-af^2-bg^2-ch^2=0$$

ELECTRIC ORGANS IN FISHES

Mrs. U. Lamba

In all animals receptor-effector system exhibits the phenomenon of electrogenesis but it is only in the case of fishes that the effector system results into an *additive electric discharge*. (Electrogenesis means the charges taking place in the charge during the passage of stimulus from receptor to effector.) Here the effector system produces electric discharge unlike others where the excitation of effector system does other work like production of energy, etc.

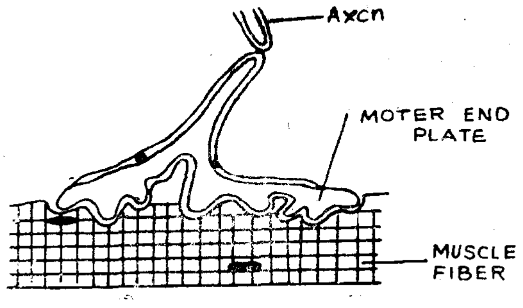
Historical :

First Bioelectric potential was recorded in electric genera of fishes by Mann. Faraday also performed an experiment on the fish *Electrophorus electricus* with galvanometer to measure the strength of electric potential. This fish was capable of producing a discharge of strength ~550 volts for a short duration.

Other fishes like *marine elasmobranchs* give a current of torpedo (45 V), Narcine (45 V), Raia (4–5 V) and *Teleosts* (*bony fishes*) lie Electrophorus (550 V), Malapterurus (350 Vk)

Origin and development :

Most of the electric organs are derived from either the muscle membrane (i e. excitable part of the muscles) or from motor end plates in general

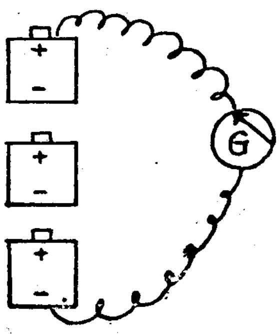


If embryonic development of electric organs is compared with related non-electric fishes, one finds that places which are occupied by muscle membrane and motor end plates are occupied by electric organs in electric fishes.

Myoblasts——→Electroblasts——→Electrocytes
or
Electroplates

Structure :

An electric organ is made up of large number of electroplates but in series and parallel series as shown in figure



Electric organ with three elecfroplates (hypothetical)

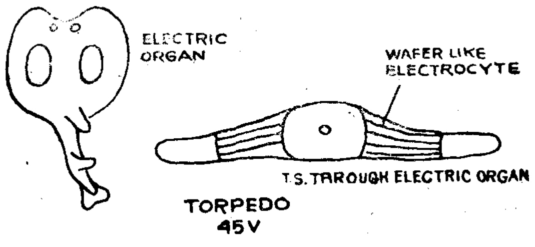
Electrophorus (electric—eel) has a total of electroplates as follows :

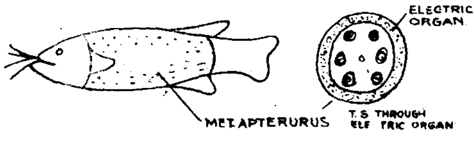
(a) In series : 6000

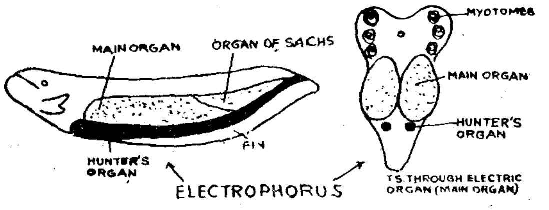
(b) In parallels : 2 × 35

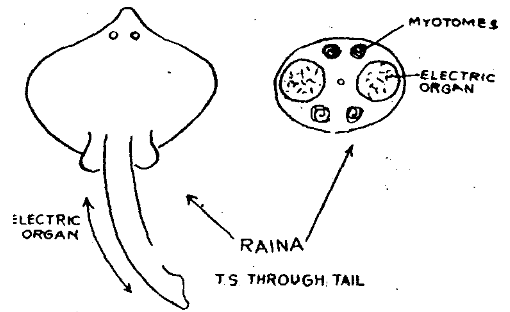
Both together can produce 550 V electric discharge. Larger the electric discharge in a fish, larger the total number of electroplates. Each individual electroplate is capable of discharge of the strength of 150 mV.

Gross Anatomy of Electric organs :





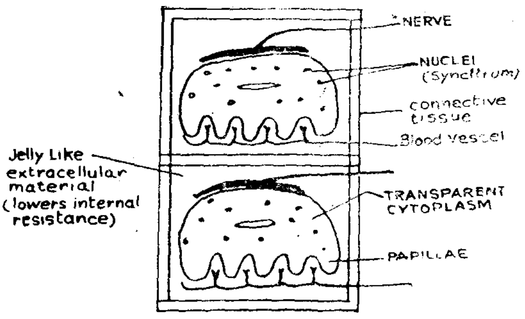




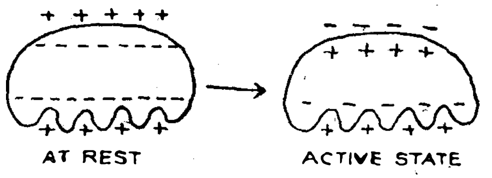
Mechanism of the additive electric discharge in Electrophorus electricus (electric eel) :

Electrophorus shows a common pattern which can be applied to all fishes except Malapterurus.

1. **Structure of Electrocytes** : These are wafer like structures. Each has two faces outer *smooth which is excitable or nervous face* Second face is thrown into papillae, has blood supply. It is *nutritional, non nervous and not excitable.*



2. **Nachman Soho's hypothesis** related to the permeability of the membrane. When electrocytes are at rest like any cell which shows electrical phenomenon, outside is positive with respect to inside which is negative. When excited outside become – ve and inside +ve so that a net electrical potential is generated which is added in series.



These changes from +ve to —ve take place due to the permeability of the membrane.

3. **Hodgkin's ionic hypothesis** : i.e. flux of ions across the membrane particularly Na^+ and K^+. According to this electrical changes the result of flux of ions cross a chemical gradient and this results in the production of electric discharge on the arrival of the stimulus.

4. **Pacini's Law** : The nervous face of electroplate becomes electrically —ve to the non-nervous face during discharge whatever may be the orientation of the electric organ as a whole. The electroplates are added up in series i.e. from an asymmetrical pattern to symmetrical pattern.

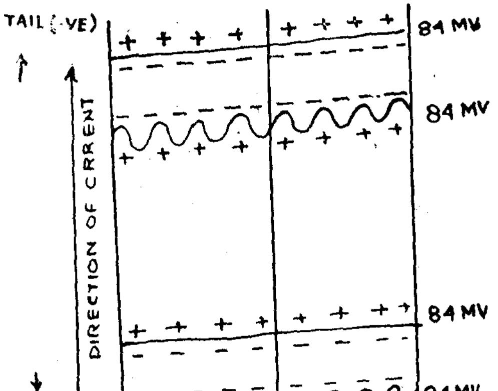


Fig A

Fig A. shows asymetrical arrangement i.e. charges on the two surfaces are equal and opposed having no external potential.

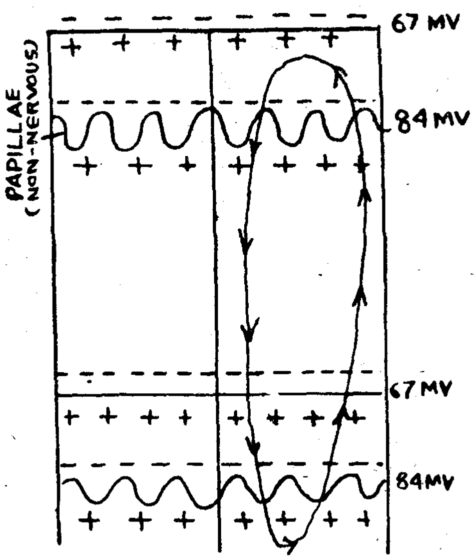


Fig B

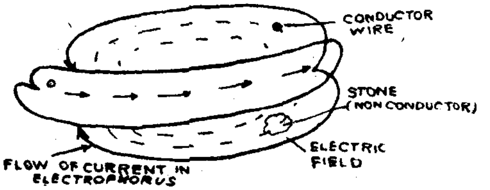
Fig B. shows symmetrical arrangement or discharge or active state. There is a net electric potential of 151 mV approximately. Current is not simply flowing but is added up in series like large number of battery cells Peak of Spike is a term used for active where current is added up in series

Functions :

1. **Pre-adaptation** for electric organ for orientation, communication and interaction between the electric genera of fishes.

2. **Offensive and defensive purposes** : If small fishes without electric organs are kept together with big fishes with electric organs, these big fishes give out strong electric current shocks and then devour them. They can also escape from predators by this electric discharge.

3. Electro-echolocation : Because of weak electric discharge, a weak electric field is generated round the fish and thus these fishes can differentrate between a conductor and a non-conductor.



The whole system works as an under water radar which helps them in finding direction.

4. **Electric Signals** : The electric signals are of value in electric genera of fishes for location, identification and recognition of sexes (This is due to weak electric discharge). Fishes are capable of detecting the pattern of electric signal.

5. **Territoriality** *Immunity of the electric fishes to their own discharge* : There are two main hypothesis regarding their immunity :

1. It is assumed that the anatomical arrangement of all the excitable tissues and organs is such that the current passes at right angles to the direction of these organs or tissues. This is not a well-established fact because on giving external shock or discharges of other fishes they get a shock.

2. Presence of unusual degree of insulation surrounding the nerves or nervous system a the muscles. Insulation is of a thick layer [illegible] fat. When these electric genera are exposed to discharges, they have a very high threshold for excitation.

Specimen	orientation of nervous face	Polarity of discharge	Total No. of electroplates in series	in parallels	Maximum discharge
Electrophorus	posterior	head +ve	6000	2×35	550 V
Malapterurus	posterior	tail +ve	1600	3000	350 V
Torpedo	ventral	dorsal +ve	400	2×550	45 V
Narcine	ventral	dorsal +ve	300	2×380	37 V
Raina	anterior	tail +ve	200	2×12	5 V

Shapes of Molecules

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New Delhi

Here we shall discuss a model which is successful in explaining the molecular geometrics of a large number of molecules. This model is called Valence Shell Electron Pair Repulsion (V.S.E.P.R.). According to this model, shape of a molecule is determined by number of electron pairs in valence shell of its central atom. Basic idea of this model is that electron pairs around the central atom in a molecule should stay as far apart as possible.

Historical Background

Octet rule and Lewis Structures

Lewis (1916) was first to recognize the importance of localized electron pairs in building the molecule. Chemical bond between atoms is identified with a shared pair of electron. Electrostatic attraction between this shared pair of electrons holds them together in chemical bond. Electrons in an atom occupy the shells following Pauli's exclusion principle and configurations such as ns^2 or ns^2np^6 and are characterised by greater stability. For the atoms of second and third periods of elements, outermost orbitals should have eight electrons. We thus obtain a rule, *Octet rule*, which states that electrons are shared in a molecule in such a manner that each atom acquires an octet.

Thus, for Li, electronic configuration is $1s^2 2s^1$, and if it joins with a flourine atom (electronic configuration $1s^2 2s^2 2p^5$) to form LiF modecule, it shares one electron with Flourine molecule. Thus Li F molecule can be represented by Lewis electron dot diagram as :

Li :F:

In these structures only electrons in outermost group of orbitals are shown, inner electrons like $1s^2$ in Flourine are not shown. These outermost orbitals are commonly called valence orbitals because they are the only ones involved in the formation of molecules.

Lewis structures of a few molecales are shown in [Fig I]

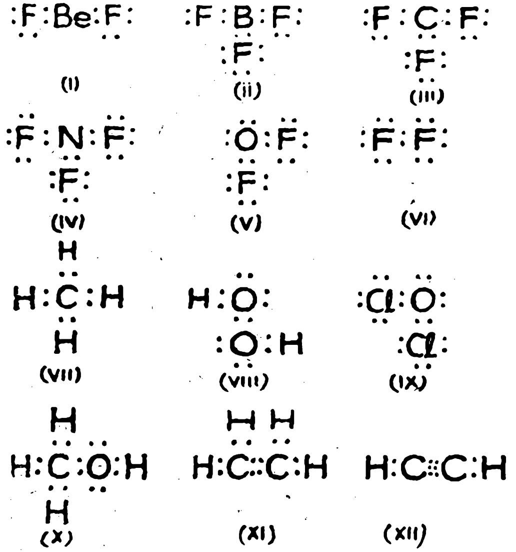


Fig. I

In 1957, *Gillespie* and *Nyholm* related the number of electron pairs in valence shell and molecular geometry. It was Gillespie who popularized the VSEPR model. Basic statement of the model is that electron pairs of valence shell tend to get as far apart from each other as possible. This corrsesponds to Pauli exclusion Principle according to which electrons with differing spin may occupy a given space while those with same spin remain apart. If we represent valence shell by a sphere, then arrangement of electron pairs can be represented by points on the sphere with sum of their distances maximized [Fig II].

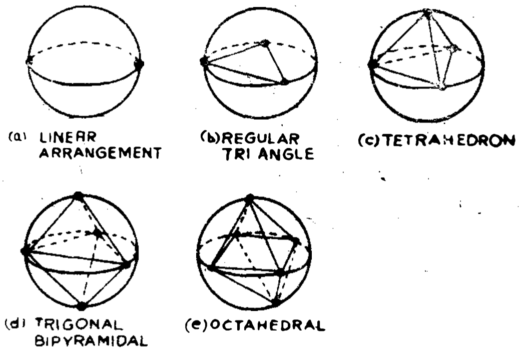
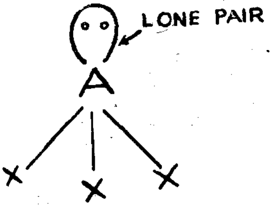


Fig. II

Configuration is determined by bond pairs and lone pairs together. If there are two electrons in shell of an atom and both form bonding pairs, molecule has a linear configuration [Fig II (a)] Molecule with three electron pairs in valence shell is trigonal planar [Fig II (b)] If there are four electron pairs, a tetrahedral configuration is formed. If one of the four pairs is a lone pair in the valence shell of the atom (as in case of NH_3) then too tetrahedral configuration is retained because it is the total number of electron pairs that determines the configuration. Configuration of three bond pairs and one lone pair of electrons is tetrahedral, so the configuration of three bonds appear as pyramidal [Fig III]



Pyramidal shape

Fig. III

In case of nitrogen triflouride (NF_3) and boron tri flouride (BF_3), although there are three flourine atoms linked to the central atom, BF_3 is planar while NF_3 is peaked pyramidal. This is because there are just three bonding pairs in valence shell of boron atom in BF_3 while there is also a lone pair of electrons in addition to three bonding pairs in valence shell of nitrogen in NF_3 [Fig IV and Fig V].

Bonding Pair and Lone Pair

H_2O molecule is bent and not planar because there are four pairs of electrons around the oxygen atom of which two are bonding and 2 are lone pairs. This arrangement is tetrahedral [Fig V].

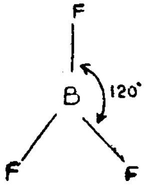


Fig. IV

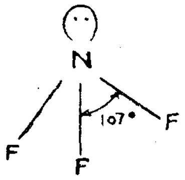


Fig. V

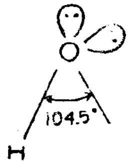


Fig. VI

All molecules with four electron pairs have tetrahedral arrangement, but it does not mean that all angles are 109° 28′ which correspond to regular tetrahedron. When there is a lone pair of electrons in valence shell, it occupies more space than a bonding pair, so there is stronger repulsion towards the other electron pairs. So there is a decrease in bond angle. If there are two lone pairs of electrons, there is more of repulsion, hence, the bond angle is decreased more. This is the reason why the bond angle in H_2O is 104.5° and that in NH_3 is 107°.

Electronegativity : i.e. ability of atoms to attract electron density is very useful in explaining chemical structures. More the electron density is drawn away from the central atom, weaker is the repulsion between electron pairs in valence shell, so bond angle decreases [Fig VII, VIII, IX].

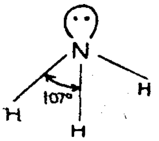


Fig. VII

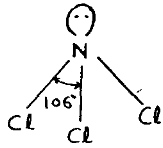


Fig. VIII

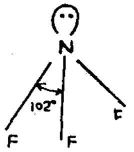


Fig. IX

Continued on Page 26→

ASTHMA

It is a common disorder of the respiratory system. It is caused by an inflection of the lower portion of the respiratory tract. This is characterised by coughing, wheezing, whistling sounds, dyspnea and pain in the chest. In the case of a severe attack, the skin and especially the lips attain a bluish tint. One gets a feeling of suffocation and has difficulty in obtaining sufficient amount of air. The incidence of these attacks may be precipitated by some incident like emotional stress, irritation, exertion or by exposure to some allergic substance.

As a matter of fact, allergy is not a disease in itself. It is considered as a symptom of the disease. About one-half of the cases of asthma result from hyper-sensitization to some allergen, which may be pollen, dust, food, etc. Others are caused by infections of some kinds. Whatever may be the cause, the result is the constriction of the bronchioles, especially during the expiration movement. So airway movement during expiration is restricted. Thus, in an asthma patient, exhalation is more difficult than the inhalation. The attack may be sudden or gradual, and may last for a few minutes, or a few hours, or even for days. But after the attack, the individual is normal, except for the fatigue. During the attack, swallowing and talking is difficult. The symptoms that appear are the result of simultaneous sporadic contraction of the muscles of the bronchioles and swelling of the tissues of the bronchial tubes. It is also believed that certain chemicals like acetylcholine and histamine are also secreted within the lung tissue which bring about the bronchial muscle spasm. It is seen that in a majority of cases, there is a hereditary predisposition to asthma, and whenever there is some allergen present, the symptoms manifest themselves.

Often the cause of the disease is a substance to which an individual has been exposed for a long time, and gets sensitized to it. [See ALLERGY—JSD, Aug. 78, Pages 38-39.] All the individuals are not sensitive to the same substance. A person may be sensitive to one allergen, while another person may be perfectly normal to it. The period of sensitization also varies from individual to individual There is a wide variety of materials which can bring about asthma symptoms. It will depend on whether a person has visited a friend who raises rabbits or dogs ; or has been to a garden or to a forest, or to a beach or has changed his hair dresser in the immediate past ; or has installed a vacuum cleaner in his house ; or has started using the dresses of some synthetic fibres, or has started taking a particular food or a particular drug. Any one of these may induce asthma. The list is long, rather an endless one. It may include pollen, pillow dust, egg, milk, mollspores, wheat and corn products, sulpha drugs, coal-tar made synthetics, pencillin and so on. But once they are eliminated, the individual returns to normal. An attack of asthma may start at any time of the day, but it is most common at night, after a few hours of sleep The individual under attack is in a most pitiable condition, not being able to expirate air from his lungs.

Prevention and Treatment

No specific cure for asthma is available ; but de-sensitization of the individual, symptomatic relief and the treatment of the accompanying infection proves useful in its prevention. To prevent asthma, one must know its cause. This is really an arduous job, but it must be done. One must systematically find out such a substance and preclude its use. The diet, the medicines one takes, clothing, and other environmental conditions must be watched. For example, if asthma is caused by pollen, one must avoid visiting gardens and forests during the flowering season. Planting of flowering plants in the vicinity of the house should be avoided. If one suffers an attack of asthma by dust particles in the air, one must not stay indoors when vacuum cleaner is on, or the room is being broomed. Such subtle matters play a very vital role in preventing the attack of asthma, and one can stay normal, though the hereditary predisposition may be present.

Asthma is also caused by emotional disturbances. So, one must always correct the psychic disturbances and must retain the perfect normal composure.

For prevention of this, a detailed history of the sufferer, his close physical examination, skin tests, prolonged observation, etc., play a very important role. This helps in establishing the relationship between trigger agents and the actual attack of asthma. For asthma patients, liquid diets are also suggested.

But once an attack of asthma has taken place, the symptoms must be treated by the doctor. During the attack, the sitting posture is best, as it facilitates the movement of air in and out of lungs. Treatment usually involves de-sensitization, symptomic relief and also the treatment of the infection. Long-term treatment includes a number of drugs, which are given to control the initial symptoms and the prevent severe attacks. Since, as already noted, within the lung tissue certain chemicals like histamine and acetylcholine are produced, so anti-histamine and anti-acetylcholine drugs are useful in relieving the symptoms Ephedrine and isoproteronol are useful in the treatment of the symptoms. Minimum doses of corticosteroids are also useful. Vapours of adrenalin, which have been atomized, may also be inhaled. Adrenalin may also be injected. Corticotropins, the hormones of anterior pituitary, are also useful in treating the symptoms.

(*Contd. from page 24*)

SHAPES OF MOLECULES

Electron density of a *multiple* (double or tripple) *bond* is more, so there is strong repulsion towards neighbouring electron pairs and bond angle decreases correspondingly.

Thus, V.S.E.P.R. model is useful in explaining the molecular shapes of various compounds and their geometrical variation.

Since the V.S.E.P.R. model does not consider the interactions between the non-bonded atoms, it fails to explain the structure of compounds where size of atoms linked to the central atom is large compared to the size of the central atom.

To the Contributors

☐ **Junior Science Digest welcomes articles on Science (all branches)—experimental and theoretical.**

☐ **Articles should be sent to JSD, 21, Shanar Market, New Delhi-110 001.**

☐ **The subject-matter of the articles should be of the level of 10 + 2 system of education.**

☐ **The matter should be either typed, or legibly written and should be sent in duplicate.**

☐ **Diagrams should be very clear and should be drawn separately with proper reference to the positions in the article.**

☐ **SI units should be used.**

☐ **The articles selected for publication will be suitably paid for.**

☐ **Articles not selected for publication will be returned only when they are accompanied with return postage.**

☐ **Contributors should also send a short note about themselves regarding their qualifications, field of work, etc.**

MODEL TEST PAPER
PREPARED BY

JUNIOR
SCIENCE
DIGEST
A SISTER PUBLICATION OF CAREERS DIGEST
MONTHLY SCIENCE JOURNAL FOR THE YOUNG

Roll No.......................................
(in words)......................................

Roll No.
(in figures)

A						

FOR

CLASSES XI & XII

National Talent Search Examination, 1979

MENTAL ABILITY AND SCHOLASTIC APTITUDE TEST

Time for Part I 90 minutes Max. **Marks 101**
Time for Part II 90 minutes Max. **Marks 99**

INSTRUCTIONS TO CANDIDATES

Read the following instructions carefully before you answer the questions. Answers are to be given on a separate answer-sheet for each part.

1. You will have to write your roll number (in English language only) and in figures (using international numerals). In the case of figures, each numeral has to be written in separate blocks printed at the right-hand top corner of the cover of this booklet and the answer-sheet. In case the roll number is less than six digits, add number of zeros before writing your actual roll number. Roll Number 322 shall, therefore, be written as following :

A	0	0	0	3	2	2

1. This test is in two parts. Part I consists of 101 questions and Part II consists of 99 questions.

3. All questions carry one mark each.

4. Since all questions in Part I and of chosen subjects in Part II are compulsory do not try to read through the whole question paper before beginning to answer it.

5. Begin with the first question and keep on trying one question after another till you finish both the parts.

6. If you do not know the answer to any question do not spend much time on it and pass on to the next one. Time permitting, you can come back to the questions which you have left in the first instance and try them again.

7. Since the time allotted to two parts of this question-paper is very limited you should make the best use of it by not spending too much time on any one question.

8. Rough work should be done on a separate sheet provided at the end of each section.

9. Remember you have to mark your answers in a SEPARATE ANSWER SHEET.

10. The answer-sheet has two Parts. Part I and II. Answers to questions of Part I are to be given in the Part I portion of the answer-sheet while to questions of Part II in Part II portion of the answer sheet.

11. Answer to each question is to be indicated by encircling the number of the correct alternative in the answer sheet from amongst the ones given against the corresponding question in the test booklet.

12. Now turn to the next page and start answering the questions.

N.B. :—**Do not write anything, except the roll number and rough work, anywhere in the booklet.**

ANSWER SHEET

Roll No.........

PART I

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PART II

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Model Test Papers

National Talent Search Examination—1979

CLASSES XI|XII

PART I

MENTAL ABILITY TEST

Time: 90 minutes

Directions: In questions 1—10, there are five groups of letters in each. Four of these groups are alike in some way while one is different. Find the one which is different and indicate this by drawing a circle round the answer number, corresponding to your answer given against the question-number in the answer-sheet.

Q. 1. (1) K P U
(2) C H M
(3) K P U
(4) G K P
(5) M R W

Q. 2. (1) H R j q
(2) j p L O
(3) N L p k
(4) P J r i
(5) T F v e

Q. 3. (1) E U g S
(2) L N n L
(3) O K q l
(4) S G u E
(5) U D w C

Q. 4. (1) J S R F
(2) O X W K
(3) Q O N M
(4) E D C B
(5) Z S R V

Q. 5. (1) M N ml
(2) G H g f
(3) R S r q
(4) D C d e
(5) Y Z y x

Q. 6. (1) M N O L
(2) E D F C
(3) G F H E
(4) R Q S P
(5) X W Y V

Q. 7. (1) P e D c
(2) n M l Y
(3) S r Q E
(4) J w V u
(5) Z h G f

Q. 8. (1) R q S p T
(2) H g I f J
(3) C b D e A
(4) M l N k O
(5) W v X u Y

Q. 9. (1) A S
(2) C T
(3) EV
(4) G X
(5) I Z

Q. 10. (1) P Q R S T
(2) S T P Q R
(3) T P Q R S
(4) Q S R T P
(5) R S T P Q

Directions : In questions 11-20, there is a question mark space in which *only one* of the five alternatives given under the question satisfies the *same* relationship as is found between the two terms to the left of the sign : : given in the question. Find the correct answer and draw a circle round the corresponding answer-number given against the question-number in the answer sheet.

Q. 11. 17 : 72 : : 19 : ...?...
(1) 84
(2) 78
(3) 81
(4) 90
(5) 94

Q. 12. 72 : 90 : : 110 : ...?...
(1) 124
(2) 125
(3) 130
(4) 132
(5) 144

Q. 13. 8 : 15 : : 5 : ...?...
(1) 16
(2) 18
(3) 20
(4) 21
(5) 24

Q. 14. 64 : 512 : : 121 : ...?...
(1) 1331
(2) 1221
(3) 1234
(4) 1150
(5) 1024

Q. 15. 21 : 54 : : 22 : ...?...
(1) 56
(2) 60
(3) 75
(4) 102
(5) 105

Q. 16. L N P : q O m : : C E G : ...
(1) f D b
(2) F D B
(3) h F D
(4) d F h
(5) h F d.

Q. 17. r P q : p Q R : : h F g · ..?...
(1) h G F
(2) g H F
(3) f G H
(4) e F G
(5) h F G

Q. 18. B F N R : q m e a : : J M E Z : ...?...
(1) y n f k
(2) y f n k
(3) i l d y
(4) y d l i
(5) i d y l

Q. 19. H O R S E : G P Q T D : : C A M E L : ...?...
(1) D B N F L
(2) D B L D M
(3) B B L F K
(4 B A L D K
(5) L E M A C

Q. 20. F A D E : 6145 : : C I B A : ...? ..
(1) 38 21
(2) 39 21
(3) 56 41
(4) 37 12
(5) 14 56

Directions : Questions 21-30 are based on number series. In each question a series of numbers is given, followed by a blank space with a question mark (?) on it. The number to be filled in the blank is given as one of the five alternatives given below each question. Find the correct alternative and encircle the corresponding answer-number, given against the question-number, in the answer-sheet

Q 21. −1,6, 23, 62, 123, ...?...
(1) 172
(2) 202
(3) 212
(4) 214
(5) 218

Q. 22. 5, 0, 13, 12, 29, 32, ...?...
(1) 53
(2) 49
(3) 47
(4) 43
(5) 37

Q. 23. − 1. 6, 20, 41, 69, 104, ...? ..
(1) 121
(2) 128
(3) 129
(4) 136
(5) 146

Q 24. 0, 6, 24, 60, 120. 210, ...?...
(1) 290
(2) 316
(3) 330
(4) 336
(5) 346

Q. 25. 6, 22, 48, 84, 130, 186, ...?...
(1) 262
(2) 252
(3) 246
(4) 230
(5) 216

Q. 26. 258, 130, 66, 34, 18, ...?...
(1) 12
(2) 10
(3) 8
(4) 6
(5) 4

Q. 27. 100, 94, 82, 64, 40, ...?...
(1) 16
(2) 14
(3) 12
(4) 10
(5) 8

Q. 28. 64, 67, 72, 36. 32, 35, 40, ...?...
(1) 16
(2) 18
(3) 20
(4) 24
(5) 25

Q. 29. 84, 42, 45, 15, 24, 12, 15, ...?...
(1) 12
(2) 10
(3) 9
(4) 6
(5) 5

Q. 30. $-\frac{7}{8}, -\frac{3}{8}, -\frac{1}{2}, -0, -\frac{1}{8}, \frac{3}{8}, \frac{1}{4},$ ...?...
(1) 1/8
(2) 3/8
(3) 1/4
(4) 3/4
(5) −1/4

Directions : Questions 31-40 are based on letter series from which some of the letters are missing The missing letters are given in the proper sequence as one of the alternatives among the five given under each question Find the correct alternative in each case and encircle its answer-number against the question-number in the answer sheet.

Q. 31. — — a a b — a — a — b a
(1) b a b a b
(2) b b a a a
(3) a b b a a
(4) a a b b a
(5) a b a b a

Q. 32. — — a a — a a — a a b —
(1) a b b b a
(2) a b b a a
(3) b a b a b
(4) a b a b b
(5) a b a b a

Q. 33. a a – a — b — a— a — b

(1) a b b b a
(2) b a a a b
(3) a b a b b
(4) a a b a a
(5) b a b a b

Q. 34. a a — a a b — a — b a —

(1) a b b a
(2) b a a b
(4) b a b a
(4) b b a a
(5) a a b b

Q. 35. b b — a — a — b b — a a

(1) a b b a
(2) b a a b
(3) b a b a
(4) b b a a
(5) a a b b

Q. 36. — b b a – b a - b a a —

(1) a b b a
(2) b a a b
(3) b a b a
(4) b b a a
(5) a a b b

Q. 37. a — a — b b — b a a b —

(1) a b b a
(2) b a a b
(3) b a b a
(4) b b a a
(5) a a b b

Q. 38. a a — b a a - a b — a a

(1) b a a
(2) b b a
(3) b a b
(4) a b a
(5) a b b

Q. 39. a – b a a — — b b a a b

(1) b a a
(2) b b a
(3) b a b
(4) a b a
(5) a b b

Q. 40. a b — a a b — — a b b a

(1) b a a
(2) b b a
(3) b a b
(4) a b a
(5) a b b.

Directions : Questions 41-50 are based on a code language. In each question, the word in column I is written in the coded language (in small letters) in column II. Study all the question carefully *together*. Then, find out the code, that is, the small letter which stands for the *italicised* capital letter of the word in each question in column I. This is your answer. To indicate your answer, draw a circle round the answer-number corresponding to the number of your answer at the top in the answer-sheet.

COLUMN I	COLUMN II				
	(1)	(2)	(3)	(4)	(5)
Q 42. NCER*T*	n	s	j	d	u
Q. 43. C*A*MEL	i	a	u	n	x
Q. 43. JOKE*S*	w	e	u	p	b
Q. 44. PROB*E*	h	w	d	q	u
Q. 45. P*L*UTO	x	c	j	h	w
Q. 46. JSDV*B*	p	k	z	q	b
Q. 47. *N*OBEL	w	s	u	x	q
Q. 48. *R*HYME	o	m	d	u	a
Q. 49. HERT*Z*	u	j	g	o	d
Q. 50. *M*AIZE	r	g	u	i	a

Directions : Read the following statements and then answer the questions 51-55 by drawing circle around the answer-number corresponding to your answer given against the question-number in the answer-sheet.

Satish, Suresh, Satyendra, Surendra and Shushil were good friends and were very good in studies. They got very good results as stated below :

(a) Satish and Satyendra got distinctions in Mathematics and Engineering Drawing

(b) Sushil and Satish got distinctions in Chemistry and Mathematics

(c) Suresh and Satyendra got distinctions in Physics and Engineering Drawing

(d) Surendra and Sushil got distinctions in Chemistry and Biology

(e) Suresh and Surendra got distinction in Biology and Physics.

Q. 51. The one who got distinctions in Physics, Chemistry and Biology is

(1) Satish
(2) Suresh
(3) Satyendra
(4) Surendra
(5) Sushil

Q. 52. The one who got distinctions in all subjects except in Physics and Biology is

(1) Satish
(2) Suresh
(3) Satyendra
(4) Surendra
(5) Sushil

Q. 53. The one, who could not get distinctions in Chemistry and Biology is

(1) Satish
(2) Suresh
(3) Satyendra
(4) Surendra
(5) Sushil

Q. 54. The one who got distinctions in Physics, Biology and Engineering Drawing is

(1) Satish
(2) Suresh
(3) Satyendra
(4) Surendra
(5) Sushil

Q. 55. The one who got distinctions in Chemistry. Mathematics and Biology is

(1) Satish
(2) Suresh
(3) Satyendra
(4) Surendra
(5) Sushil

Directions : Questions 56-65 are based on digit series from which some of the digits are missing. The missing digits are given in the proper sequence as one of the five alternatives under each question. Find the correct alternative in each case and indicate this by drawing a circle around the corresponding answer-number given against the question-number in the answer-sheet.

Q. 56. — 1 — 0 — 1 0 1 — — 1 1

(1) 1 1 0 0 1
(2) 1 0 0 0 1
(3) 0 1 1 1 0
(4) 1 0 1 1 0
(5) 1 0 1 0 1

Q. 57. — 1 0 — 1 0 — 1 1 0 — —

(1) 1 1 0 1 1
(2) 1 0 1 0 1
(3) 0 1 1 1 0
(4) 0 0 1 0 0
(5) 1 0 1 1 0

Q. 58. — — 0 1 — 0 0 — 1 0 1 —

(1) 1 1 0 0 1
(2) 1 0 1 0 1
(3) 0 0 1 1 1
(4) 1 1 1 0 0
(5) 0 1 1 1 0

Q. 59. — 0 — 0 — 0 0 — 0 0 1 —

(1) 1 1 0 1 1
(2) 1 0 1 0 1
(3) 0 1 1 1 0
(4) 0 0 1 0 0
(5) 1 0 1 1 0

Q. 60. 1 — 0 — 1 0 1 — 0 1 — 0

(1) 0 1 1 1
(2) 1 1 1 0
(3) 1 0 1 1
(4) 1 1 1 0
(5) 1 1 1 1

Q. 61. 1 — 0 — 1 0 1 — 0 1 — 0

(1) 0 1 1 0
(2) 1 0 1 0
(3) 1 0 1 1
(4) 0 1 0 1
(5) 0 0 1 1

Q. 62. 0 — 1 1 0 — 0 0 — 1 — 0

(1) 0 0 1 0
(2) 1 0 0 1
(3) 0 0 0 1
(4) 0 1 1 0
(5) 1 0 1 0

Q. 63. — 0 1 1 — 0 — 0 1 — 0 0

(1) 0 0 1 0
(2) 1 0 0 1
(3) 0 0 0 1
(4) 0 1 1 0
(5) 1 0 1 0

Q. 64. 1 0 — — 0 0 1 0 0 1 — 0

(1) 1 1 1
(2) 1 1 0
(3) 0 1 1
(4) 0 1 0
(5) 1 0 1

Q. 65. 0 — 1 0 1 — 0 1 — 0 1 1

(1) 1 1 1
(2) 1 1 0
(3) 0 1 1
(4) 0 1 0
(5) 1 0 1

Directions : In questions 66-70, some relationships have been expressed through symbols which are explained below :

△ = greater than
+ = not greater than
θ = equal to
∅ = not equal to
× = less than
□ = not less than

In each question, find the correct answer and encircle its corresponding answer-number in the answer sheet

Q. 66. a × b × c can be written as

(1) a + b + c
(2) a ∅ b ∅ c
(3) b △ a △ c
(4) c △ b △ c
(5) a □ b + c

Q. 67. a θ b + c does not imply that

(1) c ∅ b θ a
(2) c □ b θ a
(3) b ∅ c ∅ a
(4) a θ b × c
(5) b × c θ a

Q. 68. a △ b θ c θ d implies that

(1) a ⊠ b θ c
(2) b θ d
(3) d ◈ a
(4) c □ a
(5) c △ b θ

Q. 69. a □ b θ c ∅ d does not imply that

(1) d ∅ b
(2) c + a
(3) d + a
(4) a θ d
(5) d × a

Q. 70. a ∅ b θ c ∅ d. implies that

(1) a ∅ d
(2) a + c
(3) d □ c
(4) b △ d
(5) a □ b

Directions: Questions 71-75 are based on squares in which numbers have been filled according to some rule. One square has been left blank. Find the correct number from amongst those given on the right of the square which fits into the small square and encircle its corresponding answer-number given against the question-number in the answer sheet

Q. 71

—7	1	28
—4	17	8
	56	83

(1) —1
(2) 12
(3) 41
(4) 63
(5) 96

Q. 72

	56	72
2	6	12
20	30	90

(1) 8
(2) 16
(3) 36
(4) 42
(5) 64

Q. 73

0	45	155
83	42	75
93	87	

(1) 17
(2) 2[illegible]
(3) 5[illegible]
(4) [illegible]
[illegible] 5

Q. 74

0		512
343	1	64
27	125	8

(1) 625
(2) 256
(3) 289
(4) 441
(5) 216

Q. 75

18	342	19
17	13	221
391	23	

(1) 17
(2) 20
(3) 36
(4) 42
(5) 63

Directions: Questions 76-80 are based on special code given for each in the question. Study the code and find the answer for each question. Encircle the corresponding answer number given against the question-number in the answer sheet

Q. 76. In a particular code LAUGH is written as LHGAU. In the same code, SMILE may be writen as

(1) S L E M I
(2) S L E I M
(3) S E L I M
(4) S I E L M
(5) S E L M I

Q. 77. In a particular code, LEMONS can be written as EOSNML. In the same code, an industrial city in Punjab, BATALA can be written as

(1) A T A L A B
(2) A A A L T B
(3) A L A T A B
(4) B T L A A A
(5) A L A B A T

Q. 78. In a particular code MENTAL is written as MNAETL. In the same code ABILITY can be written as

(1) A I I Y T L B
(2) A I I Y B L T

(3) AIIBLTY

(4) AIIYBTL

(5) AILTYBI

Q. 79. In a particular code EXAMINATION is written as EXINIOAMATN. In the same code, QUESTION can be written as

(1) QUTIESON

(2) QETOUSIN

(3) QUSETINO

(4) QUONESTI

(5) QUSTONEI

Q. 80 In particular code, JUNIOR can be written as UJINRO. In the same code SCIENCEDIGEST can be written as

(1) SINEIETCECDGS

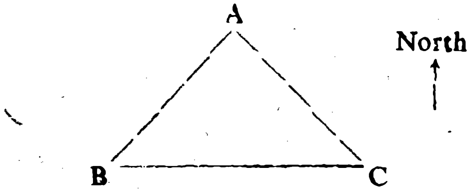
(2) SCNCIGTIEEDES

(3) CSEICNDEIGSET

(4) CSEICNEDGISTE

(5) CSEICNDEGISET

Directions : Questions 81—85 are based on the statement given below :



A, B and C are standing on the three corners of an equilateral triangle drawn in a playground. Study the questions 81-85 which are based on the figure drawn above and answer each by drawing a circle around the correct answer-number given against the question-number in the answer sheet. While answering these questions keep in view the directions as shown in the figure.

Q. 81. From the positions shown in figure, A, B and C walk along the sides in a clockwise direction and stop after travelling 1½ sides. Now indicate which one of the following statements is true.

(1) B is to the west of C

(2) A is to the south-west of B

(3) A is to the south south-west of C

(4) B is to the north-west of A

(5) C is to the north-east of A

Q. 82. From the position of Q 81, A, B and C walk in the anti-clockwise direction for the lengths of two sides and then stop. Now indicate which one of the statement is correct.

(1) C is to the east of B

(2) A is to the north B

(3) A is to west of C

(4) B is to north-west of C

(5) B is to the south-west of C.

Q 83. From the position of Q 81, A, B and C walk in the clockwise direction and stop after travelling 1½ sides. Now indicate which one of the following statements is wrong.

(1) B is to the west of C

(2) A is to the north-west of C

(3) B is to the south-west of A

(4) C is to the south-east of A

(5) C is to the west of A.

Q. 84. From the position of Q 83, A, B and C walk for 2½ sides and stop. Now indicate which one of the following statements is correct.

(1) C is to the east of B

(2) B is to the west of A

(3) A is to the east of C

(4) C is to the north-east of A

(5) A is to the north-west of B

Q. 85. From the position of Q 82, how much should each walk to come to the original position ?

(1) ½ side in the anti-clockwise direction

(2) 1½ sides in the anti clockwise direction

(3) 1½ sides in the clock-wise direction

(4) 2½ sides in clock-wise direction

(5) 2½ sides in the anti-clockwise direction

Directions : Questions 86-95 are based on following five letter series. Study these carefully and try to understand the rule in each case.

Series (1) azx, cyw, exy, gwu
(2) bay, dcw, feu, hgs
(3) acb, dfe, gih, jlk
(4) cab, fde, igh, ljk
(5) cba, fed, ihg, lkj

In each of the following questions, a term is given which belongs to one or the other of the above series. Find out to which series the term belongs and draw a circle round the answer-number corresponding to your answes given against the question-number in the answer-sheet.

Q. 86. n m m

Q. 87. o n m

Q. 88. m o n

Q. 89. k u s

Q. 90. l k o

Q. 91. u t s

Q. 92. n l m

Q. 93. m t r

Q. 94. p r q

Q. 95. q o p

Directions : Question 96-101 are verbal problems. Answer these questions by drawing a circle round the corresponding answer-number given against the question-number in the answer-sheet.

Q. 96. A is older than B by four years, whereas B is older than C by four years and is 4 times as old as D. If D is four years old, age of A is

(1) 12 yrs.
(2) 16 yrs.
(3) 18 yrs.
(4) 20 yrs.
(5) 24 yrs.

Q. 97. The sum of two digits of a number is 10. When 36 is added to the number, the digits exchange the positions. The digit in the unit place is

(1) 3
(2) 4
(3) 5
(4) 6
(5) 7

Q. 98. A student got 60 and 60% of his total marks. If his total marks are out of 200, his percentage of marks is

(1) 90%
(2) 85%
(3) 80%
(4) 75%
(5) 70%

Q. 99. First January, 1979 was Monday. First January of the year will again be Monday in

(1) 1985
(2) 1986
(3) 1988
(4) 1989
(5) 1990

Q. 100. In a pigmy saving box of a boy, 10p, 25p and 50p coins are in the ratio of 1:2:4. If the value of the coins is Rs. 33.80p, the number of 10p coins is

(1) 11
(2) 12
(3) 13
(4) 14
(5) 15

Q. 101. Two numbers are in the ratio of 3:5. If 7 be subtracted from both, the ratio becomes 1:2. The larger number is

(1) 45
(2) 50
(3) 25
(4) 30
(5) 35

PART II

SCHOLASTIC TEST

Time : 90 minutes

DIRECTIONS

Read these directions very carefully before attempting Questions in Part II.

Subjects and S. No.

1. Biology 2. Chemistry 3. Mathematics 4. Physics

1. Choose any one of the following two groups and answer all the questions out of the chosen subjects on the answer-sheet.

   Group A—Physics, Chemistry and Mathematics

   Group B—Physics, Chemistry and Biology

2. Write the subject and its serial No. (given above) at the space provided in each column of the answer-sheet.

3. Answer to each question is to be indicated by encircling the number of the correct alternative in the answer-sheet from amongst the ones given against the corresponding question in the test booklet.

4. In some of the questions, there is first a passage giving certain information and then some multiple choice items are asked. You have to answer the question in exactly the same way.

N.B. In the National Talent Search Examination conducted by N.C.E.R.T, in addition to the above four subjects mentioned, the other subjects are : 1. History, 2. Geography, 3. Civics/Pol. Science, 4. Economics, 5. Psychology and 6. Sociology. This forms Group C and for this group any three parts (out of 6 mentioned) are to be answered. This group has been excluded in JSD

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1. BIOLOGY

Q. 1. Which one of the following animals possesses a dorsal nerve cord

(1) frog
(2) cockroach
(3) hydra
(4) para moecium

Q. 2. Notochord is present throughout life in

(1) frog
(2) cockroach
(3) amphioxus
(4) balanoglassus

Q. 3. Cruciform corolla are found in family

(1) malvaceae
(2) curciferae
(3) legumenosiae
(4) gramineae

Q. 4. Hormone related with phototropism of stem is

(1) auxin
(2) gibberellic acid
(3) cytokinin
(4) abscisic acid

Q. 5. Calcium in the plants is needed for

(1) formation of root hair
(2) formation of leaf epidermis
(3) formation of cell membrane
(4) formation of cell-wall

Q. 6. Mesosomes are present in the

(1) mucor
(2) bacteria
(3) an amoeba
(4) paramoecium.

Q. 7. Duckbill-platypus is a connecting link between

(1) fishes and amphibians
(2) reptiles and mammals
(3) birds and mammals
(4) reptiles and birds

Q. 8. Enzyme responsible for digestion of proteins is

(1) pepsin
(2) trypsin
(3) erepsin
(4) all there

Q. 9. Plasmids are

(1) diatoms
(2) infoldings of plasma membrane
(3) circular DNA molecules floating inside a bacterial cell
(4) plasmolysis

Q. 10. Deficiency of vitamin A leads to

(1) stunted growth
(2) weak bones
(3) failure of blood to clot
(4) all these

Q. 11. Tetanus is caused by

(1) enamoeba
(2) plasmodium vivax
(3) wuchereria bancrofti
(4) clostridium tetani

Q. 12. Grafting will not be successful in

(1) mango
(2) orange
(3) rose
(4) maize

Q. 13. An ovum is a

(1) female gametophyte
(2) male gametephyte
(3) female sporophyte
(4) male sporophyte

Q. 14. In which one of the following fruits, edible portion is fleshy receptacle

(1) mango
(2) orange
(3) guava
(4) apple

Q. 15. The seed that germinates by epigeal germination is

(1) gram
(2) pea
(3) castor
(4) wheat

Q. 16. Plants increase in thickness due to the activity of

(1) apical meristem
(2) cambium
(3) xylem
(4) phloem

Q. 17. Pinus differs from selaginella on account of the presence of

(1) vascular tissue
(2) true root, stem and leaves
(3) spores
(4) seeds

Q. 18. Palaeontology is the study of

(1) fossils
(2) bones
(3) primates
(4) archeopteryx

Q. 19. Lateral roots in dicots, usually have their origin in

(1) pith
(2) pericycle
( ) cortex
(4) epidermis

Q. 20. Term thylakoid is associated with

(1) chloroplasts
(2) mitochondria
(3) ribosomes
(4) endoplasmic reticulum

Q. 21. Which one of the following terms is out of place

(1) basal body
(2) cilia
(3) flagella
(4) centromere

Q. 22. Hormone ACTH-RH is secreted by

(1) adrenal cortex
(2) adrenal gland
(3) pituitary
(4) hypothalamus

Q. 23. Gas which is useful in ripening of fruits is

(1) methane
(2) ethane
(3) ethylene
(4) none of these.

Q. 24. Compound which takes active part in hormone action is

(1) AMP
(2) ADT
(3) ATP
(4) C-AMP

Thought-type

Passage 1

DNA, the deoxyribonucleic acid is the all important hereditary material present in the cells of all organisms. It has three very important characteristics. Firstly, it issues instructions for synthesis of proteins. Secondly it can self-replicate i.e. can reproduce its own kind. Finally, due to alterations in the sequence of base pairs it can mutate.

Questions on passage I

Q. 25. A nucleoside differs from a nucleotide on account of

(1) absence of phosphate
(2) presence of phosphate
(3) absence of base
(4) presence of base

Q. 26. RNA differs from DNA on account of the absence of

(1) uracil
(2) thymine
(3) sugar
(4) phosophate

Q. 27. Mutation is

(1) change in base sequence of DNA
(2) change in characteristics
(3) same as variation
(4) none of these

Q. 28. During protein synthesis, amino acids are taken to the ribosomes by

(1) DNA
(2) t RNA
(3) m RNA
(4) r RNA

Passage II

Blood from the digestive tract is collected by the renal portal vein and passes through liver. Here excess glucose is retained and is converted into glycogen Some of the glycogen is also stored in the muscles and the glucose level in the blood is maintained constant. When liver and muscles have exhausted their capacity to store more glycogen excess glucose is then converted into glycogen. This conversion largely takes place in the liver.

Questions on passage II

Q. 29. Hormone needed for conversion of glycogen into glucose is

(1) glycolysis
(2) glucagon
(3) insulin
(4) hematin

Q. 30. Excess fat is usually stored

(1) beneath the skin
(2) in the liver
(3) in the kidney
(4) in the heart

Q. 31. Synthesis of fat in the body begins when
- (1) glucose is converted into glycogen
- (2) liver and muscles cannot store more of glycogen
- (3) blood glucose level is falling
- (4) blood glucose level is constant

Passage III

In the marine life diatoms enjoy a pivotal role. They are one of the most importan tprimary producers in the oceanic life. They are fed by small crustaceans who in turn are eaten by small fishes and small fishes by large fishes. Thus a food chain is formed with diatoms forming the first link in the food chain. Most of the sea animals also depend on the O_2 supplied by these tiny plants.

Questions on passage III

Q. 32. Diatoms are
- (1) algae
- (2) fungi
- (3) bacteria
- (4) bryophytes

Q. 33. First link in the food chain is always
- (1) plant
- (2) green plant
- (3) diatom
- (4) algae

2. CHEMISTRY

Q. 1. The sublimation energy for Na is less than that for Li. The ionization energy for Na is slightly less than that for Li. However the oxidation potential for Li is greater than that for Na. This can be explained on the basis of
- (1) lattice energy
- (2) hydration energy
- (3) charge on the ion
- (4) dissociation energy
- (5) binding energy.

Q. 2. A cell which has overall reaction
$Fe + Sn^{2+} \longrightarrow Fe^{2+} + Sn$
can be represented as
- (1) $Fe(s)|Fe^{2+}(aq)||\ Sn^{2+}(aq)|Sn(s)$
- (2) $Sn^{2+}(aq)/Sn(s)//\ Fe^{2+}(aq)\backslash Fe(s)$
- (3) $Sn(s)|Sn^{2+}(aq)||\ Fe^{2+}(aq)|Fe(s)$
- (4) $Sn(s)|Fe(s)||\ Fe^{2+}(aq)|Sn^{2+}(aq)$
- (5) $Fe^{2+}(aq)|Sn^{2+}(aq)||\ Fe(s)|Sn(s)$

Q. 3. K_{sp} for $CuCO_3$ is 2.56×10^{-10} mole$^2 l^{-2}$. The concentration of Cu^{2+} in a saturated solution of $CuCO_3$ is
- (1) 2.56×10^{-10} mole l^{-1}
- (2) 1.28×10^{-10} mole l^{-1}
- (3) 1.28×10^{-5} mole l^{-1}
- (4) 1.60×10^{-5} mole l^{-1}
- (5) cannot be calculated.

Q. 4. The freezing point of a 0.100 molal aquous solution of sugar is
- (1) 273K
- (2) 269.28K
- (3) 276.72K
- (4) 250K
- (5) 272.256K

Q. 5. Which one of the following is largesti n size
- (1) Ar
- (2) Ca^{2+}
- (4) Ti^{4+}
- (4) S^{2-}
- (5) P^{3-}

Q. 6. Which one of the following is optically active
- (1) n-butanol
- (2) 1-bromopentane
- (3) 3-chlorobutane
- (4) 2-chlorolmtane
- (5) butane

Q. 7. Which one of the following has the highest solubility
- (1) $C_6H_5CHOHCH_3$
- (2) $C_6H_5CH_2OCH_3$
- (3) $C_6H_5CH_2CH_2CH_3$
- (4) $pCH_3.C_6H_4COOH$
- (5) $pOH.\ C_6H_4OH$

Q. 8. Which of the following is the weakest base ?

(1) $C_6H_5NH_2$
(2) NH_3
(3) CH_3NH_2
(4) $C_2H_5NH_2$
(5) $(CH_3)_2NH$

Q. 9. Which one of the following statements is wrong ?

(1) Alkane nitrites have higher boiling than the corresponding halides
(2) aminolysis of alkyl halides gives pure amines
(3) CH_2NH_3 is a stronger base than NH_3
(4) pmethoxy aniline is a stronger base than aniline
(5) all of the above.

Q. 10. Which one of the following statements is not true for the transition elements ?

(1) They generally form coloured ions.
(2) The elements or their ions are generally diamagnetic in nature.
(3) They show pronounced catalytic activity
(4) The variation in the sizes of the atoms with the increase in atomic number is not large.
(5) All are high boiling and high melting solids.

Q. 11. Which one of the following sublines on heating.

(1) $Hg_2\,Cl_2$ (2) $Hg\,Cl_2$ (3) Hg S
(4) $K_2\,HgI_4$ (5) CdS.

Q. 12. Copper is extracted from copper pyrites Cu Fes_2. During the extraction the pyrites, are subjected to a process which gives the following products.

$2Cu\,Fe\,S_2 + O_2 \rightarrow Cu_2\,S + 2\,FeS + SO_2$

The process is known as

(1) Froth floatation
(2) Roasting
(3) Calcination
(4) Smelting
(5) Dressing

Q. 13. Which one of the following statements is wrong about noble gases ?

(1) All are chemically inert
(2) All are gases and diatomic in nature
(3) Some of them form compounds
(4) All except helium have eight electrons in their outermost shell.
(5) They either in free state or in combined state are not found in the bodies of animals.

Q. 14. Which one of the following configurations represents an element with lowest ionization energy.

(1) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,5d^{10}\,4p^1$
(2) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^1$
(3) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^8$
(4) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^1\,3d^{10}$
(5) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^{10}\,4p^5$

Q. 15. Which one of the following molecules is trigonal bypyramidal in shape.

(1) NH_3 (2) PCl_3 (3) PCl_5
(4) $Ni\,(CO)_4$ (5) SF_6

Q. 16. Which one of the following contains maximum number of atoms

(1) 1.0 ml of water at 277K and 1 atm.
(2) 22.4 ml of CO_2 at S.T.P.
(3) 6.02×10^{21} molecules of glucose $(C_6H_{12}O_6)$
(4) 5.6 g of iron
(5) A metal sheet measuring $5 \times 4 \times 1$ cm^3 and having density 10 g cm^{-3}. The atomic mass of the metal is 50.0 g mole^{-1}

Q. 17. Which one of the following has highest melting point

(1) Na^+Cl^- (2) $Mg^{2+}O^{2-}$ (3) $AlCl_3$
(4) SiO_2 (5) SnO_2

Q. 18. Which one of the following molecules will not have interaction with an external magnetic field

(1) CH_2Cl_2

(2) H_2O

(3) $BHCl_3$

(4) SO_2

(5) all of the above.

Q. 19. The principal quantum number n determines

(1) energy and probable distance of the electron from the nucleus.

(2) probable orientation of the electron change cloud.

(3) nature of the spin of the electrons

(4) size of the atom.

(5) ionization energy of the element.

Q. 20. Average kinetic energy of a molecule is proportional to

(1) mass of the molecule only

(2) pressure of the gas only

(3) temperature of the gas only

(4) temperature and pressure

(5) volume, temperature and pressure all the three.

Q. 21. Solution I contains 0.10 mole of NaCl dissolved in 500.0 g of water. Solution II contains 0.10 mole of Na_2SO_4 dissolved in 500.0 g of water.

Which one of the following is correct?

(1) I boils at a higher temperature

(2) II boils at a higher temperature

(3) I and II boil at the same temperature

(4) both I and II contain same number of Na^+

(5) none of the above.

Q. 22. Optical activity of a, substance is its

(1) colligative property.

(2) chemical property

(3) constitutive property

(4) addition property

(5) physical property

Q. 23. The factor which does not influence the enthalpy of reaction is

(1) temperature of the reaction

(2) method in which the final products are obtained

(3) physical state of the reactants and products

(4) the external pressure at which the reaction is taking place

(5) none of the above.

Q. 24. A reaction is said to be spontaneous if for the reaction

(1) $\triangle H$ is —ve

(2) $\triangle S$ is - ve

(3) $\triangle H$ is +ve and $\triangle S$ is −ve

(4) $\triangle G$ is —ve

(5) $\triangle G$ is +ve.

Q. 25. In case of a reversible reaction at equilibrium and taking place at constant pressure and temperature

(1) $\triangle G = 0$

(2) $\Delta = 0 H$

(3) $\triangle E = 0$

(4) $\triangle S = 0$

(5) $\triangle G < 0$

Q. 26. Which one of the following ionizes air to the maximum extent?

(1) X-rays

(2) β-particles

(3) Gamma rays

(4) neutrons

(5) α-particles

Q. 27. The mixing term in the reaction

$^{14}_{7}N + ^{4}_{2}He \rightarrow ^{1}_{1}H + ...$ is

(1) $^{18}_{8}O$

(2) $^{17}_{8}O$

(3) $^{17}_{7}N$

(4) $^{16}_{7}N$

(5) $^{16}_{8}O$

Q. 28 Which one of the following pairs of cations cannot be separated by H_2S in an acidic medium ?

(1) Fe^{2+}, Cu^{2+}
(2) As^{3+}, Zn^{2+}
(3) CCl^{2+}, Ni^{2+}
(4) Hg^{2+}, Sn^{2+}
(5) Pb^{2+}, Al^{3+}

Q. 29. A metal salt was heated with Na_2CO_3 and $CO.NO_3)_2$ when a green coloured ash was formed. The cation of the salt is

(1) Fe^{2+}
(2) Zn^{2+}
(3) Al^{3+}
(4) Ni^{2+}
(5) Mn^{2+}

Q. 30. Which one of the following oxides cannot be reduced easily by carbon alone ?

(1) ZnO
(2) PbO
(3) Fe_2O_3
(4) Al_2O_3
(5) SnO_2

Q. 31. Which one of the following metals is extracted by cyanide process from its sulphide ore ?

(1) Zn
(2) Cu
(3) Pb
(4) Al
(5) Ag

Q. 32. Which one of the following metals does not dissolve in aqua regia ?

(1) Au
(2) Pt
(3) Cu
(4) Ag
(5) Hg

Q. 33. Which one of the following combination of enzymes is used in the manufacture of ethanol from starch ?

(1) zymase and diastase
(2) diastase, invertase and zymase
(3) diastase, maltase and zymase
(4) diastase and maltase
(5) maltase and zymase.

3. MATHEMATICS

Q. 1. The Coefficient of $\frac{1}{x^2}$ in the expansion

$(2x+3)^4+(3-2/x)^4$ is

(a) 206
(b) 126
(c) 216
(d) 226
(e) 621

Q. 2. The firust and second term of G. P. are x^{-4} and x^t respectively and the 7th term is x^{44}, then t is equal to

(a) zero
(b) 5/2
(c) 4
(d) 4/5
(e) 12

Q. 3. If $3^{x+1}-3^{x-1}=\frac{8}{27}$ then 8^x is
- (a) 1/8
- (b) 8
- (c) —1/64
- (d) 64
- (e) 1/64

Q. 4. If $\frac{x^2-2xy+3y^2}{2x^2+3xy-y^2}=\frac{9}{4}$, then y/x is equal to
- (a) —1
- (b) 1
- (c) 3, $-\frac{1}{2}$
- (d) 2, $-\frac{1}{3}$
- (e) —2, $-\frac{1}{3}$

Q. 5. The sum to n terms of the series 4+44+444+4444+......... is
- (1) $\frac{40}{81}(10^n-1)-\frac{4n}{9}$
- (b) $\frac{70}{81}(9^n-1)\frac{4n}{9}$
- (c) $\frac{70}{81}9^n-\frac{4n}{9}$
- (d) $\frac{40}{81}7^n-\frac{3n}{4}$
- (e) none of these.

Q. 6. A coin is tossed n times, what is chance that the head will present itself an odd number of times.
- (a) 1/8
- (b) 1/20
- (c) 1/740
- (d) 1/2
- (e) 2/3

Q. 7. The standard deviation of the natural numbers 1, 2, 3........., n is
- (a) $(n^2+1)/6$
- (b) $(n^2+1)/12$
- (c) $(n^2-1)/52$
- (d) $(n^2-1)/12$
- (e) none of these.

Q. 8. The following table gives the frequency distribution of marks abtained by a batch of 20 students :

Marks	5	15	25	35	45
No of students	5	4	6	3	2

then the mean deviation is
- (a) 19.03
- (b) 21.50
- (c) 20.75
- (d) 21.63
- (e) none of these.

Q. 9. The median of the frequency distribution

10-20	20-30	30-40	40-50
42	25	58	40

is
- (a) 32.75
- (b) 30.43
- (c) 42.75
- (d) 26.32
- (e) 28.73

Q. 10. The coefficient of correlation between the heights of the father and son from the table :

height of father	65	66	67	68	69	70	71
height of son	67	68	66	69	72	72	69

is
- (a) 0.67
- (b) 0.06
- (c) 6.7
- (d) 0.76
- (e) none of these.

Q. 11. For a certain series (x, y), the standard deviation of x and y are 2, 3 respectively. If the coefficient of correlation between x and y is 0.4, then the standard deviation of the difference between x and y is
- (a) 2.65
- (b) 2.73
- (c) 2.90
- (d) 3.01
- (e) 3.25

Q. 12. If the sum of two unit vectors is a unit vector, then the magnitude of their difference is
- (a) $\sqrt{3}$
- (b) $\sqrt{5}$
- (c) $\sqrt{7}$
- (d) $\sqrt{2}$
- (e) none of these

Q. 13. $A=2i-3j-k$ and $B=i+4j-2k$, then $A\times B$ is equal to

(a) $10i+3j-11k$

(b) $10i+3j+11k$

(c) $10i-12j+11k$

(d) $10i-3j+12k$

(e) $2i-12j+2k$

Q. 14. If A and B are any two points whose position vectors are a and b, then the position vector of c, which is collinear with A and B such that $AC:CB=m:n$ is

(a) $(na-mb)/(m+n)$

(b) $(na+mb)/(m+n)$

(c) $(na+mb)/(m-n)$

(d) $(na-mb)/(m-n)$

(e) none of these.

Q. 15. The value of the determinant $\begin{vmatrix} 1 & a & bc \\ 1 & b & ac \\ 1 & c & ab \end{vmatrix}$ is

(a) $(a-b)(b-c)(c-a)$

(b) $(a-b)(b+c)(c+a)$

(c) $(a-b)(b+c)\ c-a)$

(d) $(a+b)(b+c)(c+a)$

(e) none of these.

Q. 16. If two matrices of order $m\times n$ and $n\times p$ are multiplied then the resulting matrix is of order

(a) $p\times m$

(b) $n\times p$

(c) $m\times n$

(d) $m\times p$

(e) none of these.

Q. 17. If $A=\begin{pmatrix} 0 & 1 \\ -1 & 1 \end{pmatrix}$ and $B=\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$, then AB is

(a) $\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$

(b) $\begin{pmatrix} 0 & 1 \\ -3 & 0 \end{pmatrix}$

(c) $\begin{pmatrix} 0 & -1 \\ -3 & 0 \end{pmatrix}$

(d) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

(e) none of these.

Q. 18. sin x is a periodic function with period

(1) $2n\pi$

(2) 2π

(3) -2π

(4) π

(5) $-2n\pi$

Q. 19. The value of θ satisfying the equation $\cos\theta+\sqrt{3}\sin\theta=2$, is

(1) $\pi/6$

(2) $\pi/3$

(3) $2\pi/3$

(4) $4\pi/3$

(5) $5\pi/3$

Q. 20. On the level ground the angle of elevation of the top of a tower is 30°. On moving 20 metres near the tower, the angle is 45°, then the height of the tower is

(1) $20\sqrt{3}-1$

(2) $20(\sqrt{3}-1)$

(3) $10(\sqrt{3}+1)$

(4) $10\sqrt{3}$

(5) 20

Q. 21. The equation $8x^2-6xy-27y^2+6x-6y+1=0$ represents

(1) a circle

(2) a pair of straight line

(3) a parabola

(4) an ellipse

(5) a hyperbola

Q. 22. The point in the plane of triangle which is at equal distance from the three sides of the triangle is its

(1) orthocentre

(2) incentre

(3) centroid

(4) circumcentre

(5) none of these.

Q. 23. The slope of the line joining the points (2, 5) and (4, 3) is

(1) 0

(2) 1

(2) −1

(4) 2

(5) −2

Q. 24. The third derivative of a function f (x) vanishes for all values of x. If $f(1)=3$, $f'(1)=3$ and $f''(1)=2$, then f (x) is equal to

(1) $1+2x+3x^2$
(2) $1+3x+4x^2+5x^3$
(3) $1+x+x^2$
(4) $1-x+2x^2$
(5) none of these

Q. 25. If $y=\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$, then $\frac{dy}{dx}$ is equal to

(1) $1/(1-x^2)$
(2) $1/(1+x^2)$
(3) $2/(1+x^2)$
(4) $2/(1-x^2)$
(5) $2x/(1+x^2)$

Q. 26. $\int \frac{1}{(x+1)\ (x+2)}dx$ is equal to

(1) $\log \frac{x+1}{x+2}+c$
(2) $\log \{ (x+1)/(x-2) \} +c$
(3) $\log (x^2+1) +c$
(4) $\log \{ (x^2+x)/(x+2) \} +c$
(5) none of these

Q. 27. $\int_0^{\pi/4} \frac{\cos 2x+2 \sin^2 x}{\cos^2 x} dx$ is equal to

(1) 0
(2) −1
(3) 1
(4) 2
(5) none of these.

Thought-Type

Section I

A triple $a=(a_1, a_2, a_3,)$ of real numbers is said to be three dimensional vector represented by a. The magnitude of $a=(a_1, a_2, a_3,)$ is

$$a_1{}^2+a_2{}^2+a_3{}^2$$

vectors are added by the law

$$(a_1, a_2, a_3)+(b_1, b_2, b_3) =(a_1+b_1, a_2+b_2, a_3+b_3)$$

The dot product of two vectors is defined by

$$a.b=(a_1, a_2, a_3).(b_1, b_3, b_3) =(a_1 b_1 + a_2 b_2 + a_3 b_3)$$

Two vectors are called orthogonal if their dot product is 0 (zero). The vectors i, j. k is defined by $i=(1, 0, 0)$, $j=(0, 1, 0)$, $k=(0, 0, 1)$.

Question on Section I

Q. 28. The magnitude of the vector $6i+2j-3k$ is

(1) 11
(2) 31
(3) 49
(4) 7

Q. 29. The dot product of vectors j and $2i-3j+k$ is

(1) −3
(2) 3
(3) 7
(4) $\sqrt{7}$

Q. 30. Let $a=3i-6j-24k$, the vector orthogonal to a is

(1) $-2i-5j+k$
(2) $-3i+6j-24k$
(3) $2i+5j-k$
(4) $-3i-6j+24k$

Section II

A 2×2 matrix of the form $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$, when a, b, c and d are real numbers. If A and B are matrices such that :

$$A=\begin{pmatrix} a & b \\ c & d \end{pmatrix},\quad B=\begin{pmatrix} a' & b' \\ c' & d' \end{pmatrix}$$

We have the following results :

(i) A=B if and only if
$a=a'$, $b=b'$, $c=c'$, $d=d'$

(ii) $A+B=\begin{pmatrix} a+a' & b+b' \\ c+c' & d+d' \end{pmatrix}$

(iii) $A.B=\begin{pmatrix} a\,a'+b\,c' & a\,b'+b\,d' \\ c\,a'+d\,c' & c\,b'+d\,d' \end{pmatrix}$

(iv) If A is non-singular, we define the inverse of the matrix A by

$$A^{-1} = \begin{pmatrix} \frac{d}{ad-bc} & -\frac{b}{ad-bc} \\ -\frac{c}{ad-bc} & \frac{a}{ad-bc} \end{pmatrix}$$

Question on Section II

Q. 31. If $A = \begin{pmatrix} 0 & 1 \\ -1 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$,

then A.B is

(1) $\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$

(2) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

(3) $\begin{pmatrix} 0 & 3 \\ -1 & 0 \end{pmatrix}$

(4) $\begin{pmatrix} 0 & 1 \\ -3 & 0 \end{pmatrix}$

Q. 32. If $A = \begin{pmatrix} 1 & -2 \\ 3 & -4 \end{pmatrix}$, then A^{-1} is given by

(1) $\begin{pmatrix} -4 & 1 \\ 3 & 4 \end{pmatrix}$

(2) $\begin{pmatrix} -4/3 & 2\ 3 \\ -1 & 1/3 \end{pmatrix}$

(3) $\begin{pmatrix} -2 & 1 \\ -3/2 & 1/2 \end{pmatrix}$

(4) $\begin{pmatrix} 2 & 0 \\ 3/2 & -1/2 \end{pmatrix}$

Q. 33. If $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$, $B = \begin{pmatrix} 4 & -2 \\ -3 & 1 \end{pmatrix}$, then

A+B is

(1) $\begin{pmatrix} 5 & 0 \\ 0 & 5 \end{pmatrix}$

(2) $\begin{pmatrix} 3 & 0 \\ -3 & 2 \end{pmatrix}$

(3) $\begin{pmatrix} -5 & 3 \\ -3 & 5 \end{pmatrix}$

(4) $\begin{pmatrix} 3 & 0 \\ 0 & -3 \end{pmatrix}$

PHYSICS

Q. 1. The dimensions of a physical quantity show

(1) the nature of the physical quantities involved

(2) the value of the physical quantities involved

(3) the nature and values of the physical quantities involved

(4) how its nature and value of its units are related to the magnitude of the three fundamental units

(5) None of the above.

Q. 2. The velocity-time graph is a st. line || one of the axes, the motion of the body has

(1) constant velocity

(2) non-uniform motion

(3) uniform acceleration

(4) no motion

(5) non-uniform acceleration

Q. 3. A particle of mass 0.5 kg is whirled in a horizontal circle of diameter 1 m with a uniform speed of 4 ms^{-1}. The centripetal force required to balance the centrifugal force is

(1) 2 N

(2) 4 N

(3) 8 N

(4) 16 N

(5) 10 N.

Q. 4. The total energy of a particle vibrating simple harmonically is given by

(1) $E = 2\pi^2 a^2 \nu^2 m$

(2) $E = 4\pi^2 a^2 \nu^2/m$

(3) $E = 4\pi^2 a^2 \nu^2 m$

(4) $E = 4\pi^2 a^2 m/\nu^2$

(5) $E = 4\pi^2 a^2 \nu m^2$

where the symbols have usnal meanings

Q. 5. The velocity of sound is 340 ms^{-1}. A source emitting sound of frequency 480 Hz is approaching the observer with a velocity of 20ms^{-1} while the observer is also approaching the source with the same velocity. The frequency of the sound as heard by the observer will

(1) increase
(2) decrease
(3) neither increase nor decrease
(4) either increase or decrease
(5) None of the above.

Q. 6. In the above problem, the apparent frequency will

(1) be 480 Hz
(2) increase by 8%
(3) increase by 12.5%
(4) decrease by 10%
(5) decrease by 8%

Q. 7. The ratio of intensities due to two sources separately is 25:16. When the two sources are used at the same time these produce interference fringes. The ratio of maximum and minimum intensities produced will be

(1) 41:9
(2) 5:4
(3) 9:1
(4) 9:4
(5) 81:1

Q. 8. In stationary waves, nodes and antinodes are produced. Then which of the following statements is wrong ?

(1) Nodes and antinodes are alternated and equally spaced.
(2) At node the change in pressuse is maximum.
(3) Phase difference in the nearest particles in the same segment is zero
(4) Each particle in the medium has same amplitude of vibration.
(5) The distance between nearest node and antinode is quarter of the wave-length.

Q. 9. A tuning fork of frequency 480 Hz gives 10 beats in two seconds when sounded with a sounding body. When the body is filed a little the beats heard are 6 per second. The frequency of sound of the body after being filed is :

(1) 485 Hz
(2) 486 „
(3) 474 „
(4) 475 „
(5) None of the above.

Q. 10. The velocity of sound increases approximately by 0.61 ms^{-1} for 1°C rise in temperature. This relation holds good for

(1) all temperatures
(2) all temperature differences
(3) small temperatures
(4) small temperature differences
(5) room temperatures

Q. 11. In the relation of velocity of sound in a medium γ should be adiabatic and not is thermal. This should be for

(1) gaseous medium
(2) liquids
(3) solids
(4) liquid and gaseous media
(5) all the media

Q. 12. In a young's double slit interference experiment, the fringe width is

(1) directly proportional to the wave-length of the light used
(2) dirctly proportional to the distance between the screen and plane of the slits
(3) inversely proportional to the spacing between the slits
(4) All the above are correct
(5) None of the above is correct.

Q. 13. For laser the angnlar spread is from

(1) interference alone
(2) diffraction alone
(3) dispersion alone
(4) interference and dispersion both
(5) interference and diffraction both

Q. 14. C_{rms} of air is approximately

(1) one and a half times the velocity of sound at 0°C
(2) given by the relation $C_{rms} = \sqrt{3P/D}$
(3) 2.5 km/sec.
(4) 0.1 m/sec and during this time the molecules suffer about 10^{12} collisions.
(5) constant and is independent of temp.

Q. 15. From Rutherford's experiment it was concluded that

(1) the positive charge of an atom is confined to a small volume called *nucleus*
(2) the radius of the nuclei is ~ a few fermi
(3) electrons reside outside the nuleus
(4) all the above
(5) only two of the above.

Q. 16. A fermi is equivalent to

(1) 10^{-13}m
(2) 10^{-14}m
(3) 10^{-15}m
(4) 10^{-16}m
(5) 10^{-12}m

Q. 17. According to Bohr's model, the radius of electron is given by the relation

(1) $a_0=\frac{n^2h^2}{4\pi^2mk^2Ze^2}$
(2) $a_0=\frac{n^2h^2}{4\pi^2mkZe^2}$
(3) $a_0=\frac{n^2h^2}{4\pi^2mkZ^2e^2}$
(4) $a_0=\frac{n^2h^2}{4\pi^2kZ^2e^4}$
(5) $a_0=\frac{n^2h^2}{4\pi^2m^2kZe^2}$

Q. 18. If one gm. of a substance is fully converted into heat energy, the heat in calories will be about

(1) 9.0×10^{20}
(2) 9.0×10^{13}
(3) 2.1×10^{13}
(4) 4.2×10^{13}
(5) 2.4×10^{13}

Q. 19. Electromagnetic radiation is emitted by

(1) only luminous bodies
(2) radio and television transmitting antennas
(3) bodies emitting heat and height
(4) all bodies above 0^0K
(5) all bodies at temperatures higher than room temperature

Q. 20. The value of Stefan's constant is

(1) $5.67\times10^{-5}wm^{-2}K^{-4}$
(2) 5.67×10^{-6} ,,
(3) 5.67×10^{-7} ,,
(4) 5.67×10^{-8} ,,
(5) 5.67×10^{-9} ,,

Q. 21. When a fluid passes through a constricted part of the pipe, then its

(1) velocity and pressure increase
(2) velocity and pressure decrease
(3) velocity decreases but pressure increases
(4) velocity increases but pressure decreases
(5) none of the above is correct.

Q. 22. The pressure inside a soap bubble is given by the relation

(1) $P=2\sigma/R$
(2) $P=4\sigma/R$
(3) $P=4R/\sigma$
(4) $P=2R/\sigma$
(5) none of the above.

Q. 23. In case of a thermocouple, if t_n is neutral temperature, t_c is the temp. of the cold junction and t_i is the temp. of inversion, then

(1) t_n is arithmetic mean of t_i and t_c
(2) t_n is geometric mean of t_i and t_c
(3) t_i is arithmetic mean of t_n and t_c
(4) t_i is geometric mean of t_i and t_n
(5) t_c is arithmetic mean of t_q and t_n.

Q. 24. A galvanometer of resistance 200 ohm gives a full scale deflection when a.p.d. of 50 volts is applied across its terminals. In order to read upto 200 volts with the same galvanometer

(1) 400 ohms should be used in series with it
(2) 450 ohms should be used in series with it
(3) 600 ohms should be used in series with it
(4) 750 ohms should be used in series with it
(5) none of the above.

Q. 25. In order to read 2.5 amp with the above galvanometer, we should use in parallel a shunt of resistance

(1) 200/9 ohms
(2) 200/11
(3) 100/9
(4) 50/9
(4) 200/19

Q. 26. 1 amu is approximately equal to

(1) 9 31 eV
(2) 9.31 MeV
(3) 0.931 GeV
(4) 1-66 $\times^{-24}$ kg.
(5) 1.66×10^{-26} kg.

Q. 27. For a rhombohedral crystal, we have

(1) $a=b=c$ and $\alpha=\beta=90\neq r$
(2) $a\neq b\neq c$ and $\alpha=\beta=r=90$
(3) $a=b\neq c$ aad $\alpha=\beta=r=90$
(4) $a=b=c$ and $\alpha=\beta=r\neq90$
(5) $a\neq b\neq c$ and $\alpha\neq\beta\neq r$

Q. 28. The planet farthest from earth is

(1) Saturn
(2) Pluto
(3) Neptune
(4) Uranus
(5) Jupiter

Q. 29. Around the sun, the planet with largest volume is

(1) Saturn
(2) Pluto
(3) Neptune
(4) Uranus
(5) Jupiter

Thought-type

Passage

There are several ways to excite a valence electron to a higher-energy state in crystals. This can be done by the absorption of sunlight or other radiations or by a strong electric field. After a time interval ranging from micro-seconds to minutes, the electron generally returns to its ground state The transition to the ground state is usually accompanied by dissipation of some energy. If a fraction of this absorbed energy is re-emitted in the form of electromagnetic radiation in the visible or near-vissible region of the spectrum, the phenomenon is called luminescence. If the crystals emit light simultaneously with excitation, the process is called fluorescence; if it takes a micro-second or longer to emit its light photons, then the process is called phosphoroscence. Luminescent solids are usually referred to as phosphors. Most crystals do not luminescence in their pure state; in fact, the luminescence generally occurs when the crystal contains impurity atoms called activators. The different kinds of luminescence possible in crystals also depend on the means employed to excite the electron. Photoluminescence occurs when the excitation is accompanied by the absorption of photons. Cathodoluminescence results when a phosphor is bombarded by high energy electrons. Electroluminescence occurs when a phosphor is placed in an insulating medium having a very high dielectric constant and an electric field is applied across the crystal. The emission of light resulting from heating after excitation is referred to as thermoluminescence. Triboluminescence is when two fairly hard insulators for example, two quartz rocks, are briskly rubbed together.

Question on above passage

Q. 30. A common phosphor is

(1) Galeno (Pb S)
(2) Calcite (Ca CO_3)
(3) Zinc sulphide (ZnS)
(4) Rocksalt (NaCl)
(5) none of the above.

Q. 31. Fluorescent tubes and lamps exhibit

(1) thermoluminescence
(2) photoluminescence
(3) electroluminescence
(4) cathodoluminescence
(5) triboluminescence

Q. 32. The picture tube screens in television sets operate on

(1) photoluminescence
(2) cathodoluminescence
(3) electroluminescence
(4) thermoluminescence
(5) triboluminescence

Q. 33. A visible-light photon emitted from certain phosphors has energy of the order of

(1) KeV
(2) eV
(3) MeV
(4) GeV
(5) none of the above.

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Science Quiz-May '79

The solution of this Science Quiz is invited from the readers of JSD. The names of the first ten persons giving all-correct answers will be published in the July, 79 issue of the magazine. Each of them will also be sent FREE copy of the JSD for 12 months from July '79 issue of the magazine. The solution to the quiz should be sent to JSD, 21, Shanker Market New Delhi-110 001 and should reach by 20th of May 1979.

Q. 1. On a tuning fork 'F' is written. What is its frequency of vibration ?

Q. 2. If two plane mirrors are inclnined at an angle θ and the object is placed between them, then how many images are formed due to successive reflections. (Give the relations (s) if any).

Q. 3. Who discovered neutron ?

Q. 4. In a Bunsen's grease-spot photometer, light from a lamp with a dirty chimney is exactly balanced by that of a candle distant 10 cm. from the spot. When the chimney is cleaned, the candle has to be shifted by 2 cm. to obtain balance. What percentage of light is absorbed by the dirty chimney ?

Q. 5. A faulty thermometer has its fixed points marked 5° and 95°. What is the correct temperature in centigrade when this thermometer reads 68° ?

Q. 6. After how much time will the two hands of a clock coincide after 12 O' clock ?

Q. 7. A reduction of 20% in the price of sugar enables a person to buy 4 kg. *more* of sugar for fifty rupees. What is the reduced and original price of sugar ?

Q. 8. The resultant of two forces A and B is C. The resultant is doubled whed A is doubled; and is also doubled when A is revered. What is the ratio of A:B:C ?

Q. 9. What is the chemical formula of quinine and what is its natural source ?

Q. 10. What is dry ice and what is the reason of this name ?

Q. 11. What is a *sidereal* day ?

Q. 12. An adult has 32 teeth, but these form some groups. Name the groups with the number of teeth in each.

Q. 13. Which different portions of our tongue are used for telling different tastes ?

Q. 14. What is the principle of Davy's safety lamp in mines ?

Q. 15. Why do the cat's eyes shine in dark ?

Q. 16. How fast can an ostrich run ? How many toes does it have on each foot ?

Q. 17. What is a glass-frog ?

Q. 18. Give the next two numbers in the series :

4, 12, 6, 18, 9, ...,......

Q. 19. An alloy of 2/3 copper and 1/3 tin, used for mirrors and reflector is called ....?

Q. 20. Ammonium chlorostannate, $(NH_4)_2SnCl_6$ which is used as mordant in dyeing is also calleed...............

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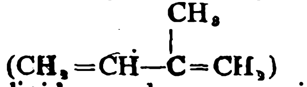
Solution

Science Quiz-March'79

Here is the solution of the Science Quizpublished in March '79 issue of the JSD. The list of persons giving all correct entries is given somewhere in the magazine. The magazine is being sent to them FREF for 12 months from May issue.

1. The bill of the employer will decrease.
2. Carotenoids are the polymers of hydrocarbon isoprene



$$(CH_2=CH-\overset{\overset{\textstyle CH_3}{|}}{C}=CH_2)$$

These are lipids and occur in carrots, tomatoes, green leaves, egg yolk etc.
3. If the capillary tube is further pushed inside, the water will not overflow. In this case, the shape of the maniscus will so change as to maintain the required pressure difference.
4. Triple phosphate is calcium dihydrogen phosphate $Ca(H_2PO_4)_2$. It is obtained by the action of phosphoric acid on calcium phosphate. It is used as a phosphate fertilizer.
5. The two numbers with base 5 [illegible] are 321, (ii) 234; their sum $= 1110$
their product $= 142214_5$
their difference $= 32_5$
6. original fraction = 13/19.
7. Chemotherapy is the treatment by chemical substances which are toxic to the causitive *micro-organisms* or which directly attack *neoplastic* growths.
8. Alpha-naphthyl-thio-urea.
9. Red (visible) light has large wave-length and larger the wave-length smaller is the dispersion. So red light can travel comparitively large distances without suffering appreciable dispersion as compared to other visible lights. For this reason it is prefered for signalling.
10. Earth rotates from west to east about its axis, so a person living in the east (Calcutta) will see the rising sun earlier than one in the west (Bombay).
11. The amount of heat evolved when one mole of gas or vapour is adsorbed on a solid is known as molar heat of adsorption.
12. Theoretically nothing is consumed in a lead accumulator except water which is lost due to evaporation. The ultimate source of energy is the electrical current itself which is used in chargiug the accumulator.
13. Group-O
14. Sequoia
15. Dopant is an impurity added to a semiconductor to achieve a particular characteristic
16. Longitudnal waves travel through a Kundt's tube.
17. Halogens show colour due to the presence loosely bound electrons. These electrons are easily excited and absorb visible light and hence show different colours.
18. The migration of the colloidal particles under the influence of an applied field is called electrophoresis.
19. 25% profit.
20. Sodium metabisulphite acts as fruit products preservative because in solution it decomposes on standing, giving SO_2

$Na_2S_2O_5 \longrightarrow Na_2 + SO_2$.

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S.I. Units And Their Importance

Puran Chhabra
D.K. Mainrai

The question of units and dimensions in electricity and magnetism has involved quite many physicists and engineers over the years. This situation is marked in contrast with the almost universal agreement on the units of length, mass and time. The reason perhaps can be attributed to the fact that the mechanical units were defined when the idea of "absolute" standards was a novel concept, and they were urged on the professional and commercial world by a group of leading scientists like Borda, Laplace etc. The problem of electromagnetic units brought many experts into limelight, who are still working on them. The purpose of this article is to add as little heat and as much light as possible without elaborating the whole issue.

The *arbitrariness* in the *number* of fundamental units and in the *dimensions* of any physical quantity in terms of those units has been stressed by Planck, Bridgman, Abraham, Birge and others.

The desirable features of a system of units in any field are (i) convenience and (ii) clarity. For example, theoretical physicists active in relativistic quantum field theory and the theory of elementary particles find it *convenient* to *choose* the universal constants such as Planck's quantum of action and the velocity of light in vaccum to be *dimensionless* and of *unit* magnitude. The resulting system of units, called—"natural units", has only one basic unit, commonly chosen to be length. All quantities, wheather length force, time or area, etc., can be expressed in terms at this unit, having dimensions which are power of its dimensions. There is nothing contrived or less fundamental about such a system than one involving, the metre, the kilogram, and the second as fundamental units. It is only a matter of convenience.

The S.I. system of units has specially proved to be particularly advantageous in the calculations of *atomic physics.*

The fundamental units of classical physics are, the unit of mass—gram, the unit of length-centimetre and the unit of time—second. These three units combined together, can give rise to units of any physical quantity, in mechanics: commonly known as C.G.S. system of units. But these units receive a set back, when extended to electrical quantities or units. In fact, an additional unit is required which results in the birth of different systems according to the choice of this unit. Like *C.G.S. electrostatic* unit system of units (e.s.u.) was defined from Coulomb's law of electrostatic repulsion or attraction between two point charges q and q′, separated by a distance r as $F \propto \frac{q\,q'}{r^2}$, where the constant of proportionality arbitrarily assumes a value equal to one in free space. While the study of magnetism leads to another system of units, namely *C.G.S. electromagnetic system* of units, (e.m.u), defined by Coulomb, for two isolated magnetic poles m and m′, separated by a distance r, then the force of attraction or repulsion F, is $F \propto \frac{m\,m'}{r^2}$ where again the constant of proportionality was given a value equal to one in free space. In addition to these, complications arose again, when engineers evolved a practical system of units e.g. volt, ampere, joule, watt etc. And thus burdening a student in learning all systems and their corresponding relationships. This represents a very serious duplication of effort and renders the understanding of electricity unnecessarily difficult. For examble, the charge of the electron is 1.6×10^{-20} e.m.u, 4.8×10^{-10} esu, or $1.6 \times {}^{-}10^{19}$ coulomb, according to the system adopted.

The *metre-kilogram-second* (m.k.s) system of units was chiefly devised to overcome the above difficulties and lessen the confusion that results from the mixing use of the practical system, esu and emu systems. As early as 1901 Giorgi pointed out that if the fundamental units of mass, length and time were changed to the kilogram, metre and leaving the unit of time as second, unchanged, a great simplification would follow. These changes led at once to the practical units of the metric system such as the joule and the watt.

Furthermore, a fourth fundamental electrical unit may also be chosen so that all the derived electrical units become practical ones as well. Thus, now, with us, we have the metre-kilogram-second (S.I.) system which is a single, unique, consistent and convenient system of units (*all in one*), applicable to all sciences of Physics.

Developing this system first, in mechanics, we have, only one new unit, the *newton*. Thus

$$M = 1 \text{kg}$$
$$L = 1 \text{ m}$$
$$T = 1 \text{ s}$$

The acceleration, 'g' due to gravity becomes 9.81ms^{-2}. Thus using Newton's second law of motion, we know that, force is the product of mass and acceleration, so that unit of force is =(unit of mass) × (unit of acceleration).

$$\text{or} \quad F = m \times a$$

$$\begin{aligned} \text{S.I. unit of force} &= 1\text{kg} \times 1\text{ms}^{-2} \\ &= 10^3\text{g} \times 10^2\text{ms}^{-2} \\ &= 10^5\text{g m s}^{-2} \\ &= 10^5 \text{ dynes} \end{aligned}$$

Thus, the S.I. unit of force, known as newton, is equal to 10^5 dynes. Similarly, S.I. unit of work or energy is defined as when 1 newton of force acts on a system, so as to produce a displacement of 1 m. Or

$$W = F\downarrow \times D\downarrow$$

$$\begin{aligned} \text{S.I unit of work or energy} &= (1 \text{ newton} \times 1 \text{ m}) \\ &= (10^5 \text{ dynes} \times 10^2\text{cm}) \\ &= 10^7 \text{ dynes cm} \\ &= 10^7 \text{ ergs} \\ &= 1 \text{ Joule.} \end{aligned}$$

Which is the practical unit of work or energy in the metric system.

The laws of electricity and magnetism are derived from these basic laws which have an experimental origin. Thus, as stated above, the force F, between two charges q and q′, separated by a distance r, in vacuum, is

$$F = \frac{q\,q'}{a.\,r^2} \quad \text{(a being constant)}$$

The law of force between two imaginary magnetic poles m and m′, separated by a distance r, in vacuum, is

$$F = \frac{m \times m'}{b.\,r^2} \quad \text{(b being a constant)}$$

Again, according to Biot-Savart law giving the magnetic field δB due to a current I flowing in a conductor of length δl at a distance r, in vacuum, is

$$\delta B = \frac{I\,\delta l.\,\sin\theta}{c.\,r^2} \quad \text{(c being constant)}$$

Thus, we have, with us three basic constants, in the form of a, b and c and various system of units are possible depending upon their choice. Some of these are given in the table below.

Units		a	b	c
(X) C.G.S	(i) e.s.u	1	$\frac{1}{c^2}$	1
	(ii) e.m.u	$\frac{1}{c^2}$	1	1
(Y) S.I.	S.I.U.	ϵ_0	μ_0	$\frac{1}{\mu_0}$
	S.I.R.	$4\pi\epsilon_0$	$4\pi\mu_0$	$\frac{4\pi}{\mu_0}$

ere ϵ_0 is the permittivity constant for free space and

μ_0 is the permiability constant for free space.

c is the velocity of light in free space. In the above table (X) we see how C.G S system gives rise to e.s.u and e.m.u system of units. And also in (Y) we have S I.U. (U—unrationalized) and S.I.R (R—*rationalized*) *in the* S.I. *system* We usually prefer the S.I.R system of units as it leads to formula in which 4π is associated with spherical symmetry, 2π with cylindrical symmetry and 'No' "π" with rectangular symmetry. For example, the capacities of various forms of capacitors are given below.

	S I.R.	S I.U.
Sperical	$\frac{4\pi\epsilon_0 ab}{b-a}$	$\frac{\epsilon_0 ab}{b-a}$
cylinderical	$\frac{2\pi\epsilon_0 l}{\ln b/a}$	$\epsilon_0 \frac{1}{2\ln b/a}$
plane	$\epsilon_0 \frac{A}{r}$	$_0\frac{A}{4\pi r}$

where A → area of plates separated by a distance r

l → length of cylinders of radii a and b

Thus, one can appreciate, the logic behind to choose the S.I.R. system of units and not S.I.U. system of units.

Let us now find out the value of $4\pi\epsilon_0$ from the definitions of basic constants. In e.s.u., we have, using Coulomb law of force between two charges,

$$1 \text{ dyne} = \frac{(1 \text{ e.s.u}) \times (1 \text{ e.s.u})}{1 \text{ cm} \times 1 \text{ cm}}$$

(in vacuum)

As calculated

$1 \text{ dyne} = 10^{-5}\text{N}$

and $1 \text{ e.s.u.} = \frac{1}{3\times10^9}$ coulomb, we have in S.I,R. units.

$$10^{-5}\text{ N} = \frac{\left\{\frac{1}{3\times10^9}\text{ coulomb}\right\}\times\left\{\frac{1}{3\times10^9}\text{ coulom}\right\}}{4\pi\epsilon_0\left\{\frac{1}{100}\text{ metre}\right\}\left\{\frac{1}{100}\text{metre}\right\}}$$

$$\text{or } 10^{-5}\text{ N} = \frac{1}{9\times10^{18}}\times10^4\ \frac{c^2}{m^2}\times\frac{1}{4\pi\epsilon_0}$$

$$\text{or } \frac{1}{4\pi\epsilon_0} = 9\times10^{14}\times10^{-5}\ \text{Nc}^2\text{m}^{-2}$$

$$\frac{1}{4\pi\epsilon_0} = 9\times10^9\ \text{Nc}^{-2}\text{m}^2$$

$$\text{or } 4\pi\epsilon_0 = \frac{1}{9\times10^9}\ \text{N}^{-1}\text{c}^{+2}\text{m}^{+2}$$

$$= \frac{1}{9\times10^9}\ \text{farads per metre}$$

In the above discussion, coulomb, in S.I. units has been defined in terms of current (i.e. di/dt) unit as ampere. As a matter of fact ampere is the 4th fundamental unit *defined* by the International Committee as that current which is given by Biot-Savart law as

$$F = \mu_0 . \frac{I_1 \times I_2}{2\pi\times r}$$, where F is the force per metre length, I_1 and I_2 are the currents flowing in the wires separated by a distance and is defined as that current which flows through two parallel, thin, indefinitely long wires separated by a distance of 1 m in vacuum, so that the force between them is $2\times10^{-7}\ \text{Nm}^{-1}$. Thus, we can find μ_0 from the above definition as below :

$$2\times10^{-7}\ \frac{\text{N}}{\text{metre}} = \frac{\mu_0\ (1 \text{ ampere})\times(1 \text{ ampere})}{2\pi\ (1 \text{ metre})}$$

or $\mu_0 = 4\pi\times10^{-7}\ \text{Nc}^{-2}\text{s}^{+2}$ or henry m^{-1}.

Another, interesting result follows, from the value of ϵ_0 and μ_0, we have

$$\mu_0 = 4\pi\times10^{-7}\ \text{Nc}^{-2}\text{s}^2$$

$$\epsilon_0 = \frac{1}{4\pi\times9\times10^9}\ \text{c}^2\text{N}^{-1}\text{m}^{-2}$$

$$\mu_0\epsilon_0 = \frac{4\pi\times10^{-7}}{4\pi\times9\times10^9}\ \frac{\text{Nc}^{-2}\text{s}^2}{\text{c}^2\text{N}^{-1}\text{m}^{-2}}$$

$$\text{or } c^2 = \frac{1}{\mu_0\ \epsilon_0} = 9\times10^{16}$$

$$\text{or } c = \frac{1}{\sqrt{\mu_0\epsilon_0}} = 3\times10^8\ \text{ms}^{-1}$$ which is velocity of light.

The foregoing represents the traditional approach to the teaching to electricity and magnetism and how S.I.R units are related to the various forms of C.G.S. and practical units. The approach, of course, believes the existence of monopoles, which is not possible. In fact magnetic forces are due to the forces between electric currents.

According to 1966 report on the *Teaching Electricity*, avoid the use of monopoles, replacing them by the force between two small conductors, thus, giving the value of μ_0

Thus, in nutshell, we——have the basic S.I.R. units as

1. length	metre	m
2. mass	kilogramme	kg.
3. time	second	s
4. current	ampere	A

along with the one additional unit of thermodynamics and one of photometery as :

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Vinod Kumar Chaudhary,
Patna-3

Q. What is difference between antibody and antigen ?

Ans. Antigens are the foreign proteins that stimulate the special proteins (globulins) known as antibodies. These antibodies react in various ways with the antigens to counteract their poisonous effects.

Satya Brata Dhar,
Gauhati-6

Q. It was already proved that our hair and nails are dead. If it is so, then how can we prove that our hair and nails are growing automatically day-by-day ? Please explain clearly.

Ans. Put a small silver nitrate mark on the proximal end of your nail. After some days you will see that the black mark has moved ahead. This clearly shows that nails are growing.

Shyamal Kumar Mozumdar,
Kasemnagar (W.B.)

Q. Why is the tail of a small houselizard formed, once it breaks up.

Ans. New tail is formed because houselizard possesses the power of regeneration.

Arun Kumar Patra,
Durgapur

Q. What is meant by 'Theory of recapitution'?

Ans. This theory was given by Haeckel. According to this theory, the embryonic development of an ovun (ontogeny) repeats the evolutionary development of the phyla (phylogeny) and because animals have evolved one phylum after one-another, their embroys still pass through this same succession of evolutionary stages.

Debashis Khan,
Bankura

Q. Why stool is not a excretory product?

Ans. Excretion is the process of removal of the metabolic wastes produced in the body, while stool is simply the undigested portion of food. Its removal is known as egestion and not excretion.

Prabir Kumar Mandal,
Darjeeling

Q. Colour-blindness is controlled by a sex-linked recessive gene. A normal woman marries a colour blind man. Is the colour-blind *grandson from their* son or daughter ?

Ans. Marriage between normal woman and a colour-blind man will produce normal sons and carrier daughters in the ratio of 1 : 1. Thus in the next generation daughter can bear colour-blind children.

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